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THE MIDSUMMER NUMBER.

There probably never was a summer time in the history of the comparatively new electrical industry in which commercial work continued so actively as during 1903. In many branches it has kept ahead of possible supply and, notwithstanding numerous delays due to strikes and lack of raw material, the general development is evident in all directions. Advance orders and proposed installations for the fall are to be noted already, and it is believed that the usual autumn activity will be fully one month ahead of former seasons. The electrical industry is enjoying an undoubted boom in nearly every one of its numerous branches.

Manufacturers are eagerly grasping good opportunities to exploit standard products, and modifications of old and developments of new apparatus. The consulting and constructing engineer, the professor and the student are preparing for the opening of a new campaign with every faculty alert and with ambitions keyed to do even greater things if this be possible. Contemporaneous with this condition is the present issue, the Midsummer Number, of the ELECTRICAL REVIEW. This issue will reach an extensive territory, both at home and abroad, where its diversified contents will be read with appreciation, as reflecting the influence of modern views in working up to future events.

THE INTERNATIONAL ELECTRICAL CONGRESS.

We are impressed by the plan and scope of the International Electrical Congress which will convene in St. Louis in September, 1904. A plan which contemplates an organization embracing the active working participation of all of our national electrical associations and an official co-operative representation by the national electrical societies of all the great nations which have accepted the invitation of the United States to participate in the Louisiana Purchase Exposition, is a plan that should have the united support of every electrical interest. It marks a movement along right lines, and better still the committee of organization that has conceived the plan is made up of men whom we know in the perspective of their achievements.

In spite, then, of the broad scope of the Electrical Congress of 1904, we believe it will have great success and mark a distinct step in our progress.

Professor Elihu Thomson, the president, has long ago won the esteem of his countrymen and the admiration of the whole electrical fraternity.

Mr. Arnold, the chairman of the executive committee and the newly elected president of the American Institute of Electrical Engineers, is a type of the well-balanced American electrical engineer of the younger generation; a type that is attracting attention the world over. It is excellent that he should be in an authoritative position at this international gathering.

As we look back and review the work of the previous electrical congresses, we find that they have left a strong impress upon the electrical activities of the world. The coming electrical congress can be of greater benefit than any of these, as the topics which are now open for the consideration of the chamber of official delegates of the countries to be represented have greatly broadened. Our electrotechnical nomenclature needs to be rounded out to the extent of fully meeting the demands of our work in the university, in the research laboratory and in the practical field. International standards of electromotive force, current and illumination should receive deliberate attention, be revised and, if possible, recommended for international adoption.

More than this, can not this electrical congress make the record of bringing about, if not the realization, at least the initiation of an international code for the standardization of electrical apparatus and appliances?

THE PROBABILITIES OF WIRELESS TELEPHONY.

The unceasing interest in methods of communication without wires must include what is being currently done in "wireless telephony." Of the many systems that have come up, that of Ruhmer, with his extension of the old photophone of Professor Bell, has reached the greatest success to date. In his hands, the Teutonic capacity for taking infinite pains has resulted, as it often does in experimental work, in reaching kilometres with a very dependable apparatus, where the best American results known, using a burnt cork receiver and a parabolic reflector for arc light or sunlight, have only reached furlongs. It only needs a further degree of perfection to make Ruhmer's apparatus of immense value in military and naval signaling; unless, indeed, conservatism should step in in defence of the time-honored signal flag and wig-wag systems, just as "Morse" has held its own in railway train despatching in spite of the thoroughly demonstrable superiority of the telephone. Such use need take no account of any inferiority for general use to the present telephone employing a wire line; there is no reason why the wireless system should not find for itself quite as

many special uses, all independent of a "central office," as space telegraphy itself is finding to-day.

High-Frequency Wave Telephony Difficult.

Coming now to the methods employing high-frequency electric waves, we find ourselves at once upon ground where, at this writing, angels and stock companies may well fear to tread. To any one who has ever worked in the more understandable and positive field of space telegraphy, wherein the very necessity for making new precedents and special instruments bearing no relation to old telegraph methods has itself facilitated experimental development, the necessity of adapting existing telephone instruments to the handling of frequencies comparatively very high, even at their lowest obtainable rate of vibration, presents formidable difficulties involving, in the last analysis, not mere improvement in present apparatus but the employment of entirely new methods of working that will probably bear little resemblance to present-day telephone communication.

Problems to Be Solved.

Another point is that a pair of telephones working over a wire line of any length comprises a singularly inefficient example of "power transmission;" it is only the classic sensitiveness of the telephone receiver that makes communication practicable. Now, remembering that electric waves distributed from a sending antenna proceed in all directions, normal to the antenna, inventors in this field would do well to figure for themselves, in advance of any great expenditure of brains or money, the enormous losses that must take place before a receiving station can be reached. A practical method of superposing the slow vibrations of articulate speech upon the more rapid Hertzian vibrations in a sufficiently powerful sending apparatus, together with a sensitive and dependable detector possessing the property of complete and instantaneous auto-decoherence, will go a long way toward a success comparable or even perhaps surpassing the present limits of space telegraphy.

TRACING ALTERNATING-CURRENT WAVES.

The electromotive force generated in an alternating-current apparatus is, of course, an alternating one. That is to say, an alternating current flows, according to the usual method of describing this phenomenon, first in one direction and then in the other, through the conducting wire. This alternating current, then, varies in intensity from instant to instant and it becomes desirable to learn just in what way this variation is taking place.

Methods of Tracing Waves.

There are two general methods of tracing the form of an alternating-current wave. The first method to be used is due to Joubert. This has been modified and improved in a number of ways by various experimenters. In principle, it consists in determining the difference of potential existing at some particular instant. If this is done for a sufficient number of points sufficiently close together in time, the values may be plotted in the form of a curve, and in this way the general character of the wave is shown. In the second method an apparatus is used, which is so delicate that it will follow accurately all variations in the current flowing through a small magnetizing coil. The motion of the apparatus being used to produce a permanent record of the current variations.

The Contact Method.

In the first method some form of contact maker is used. A contact maker is merely a device, which, for a very brief instant, closes an electrical circuit, and the closing of this contact is made to produce a reading by means of suitable apparatus, which is proportional to the difference of potential existing in the circuit at the instant it is closed. In Joubert's method, the closing of the circuit by the contact maker is made to charge a condenser, which is then discharged through a ballistic galvanometer, the throw of the galvanometer being proportional to the electromotive force at the instant of closing the circuit. The first contact makers were very crude, but later experimenters brought this apparatus to a high degree of perfection.

Modifications of the Contact Method.

The ballistic galvanometer is tedious and unsatisfactory for work of this kind, but it may be replaced by a suitable direct-reading dead-beat instrument. A pretty modification of this method consists in adapting to it the principle of the potentiometer. In this method the instantaneous alternating electromotive force is balanced by a direct but variable electromotive force, which is easily measured. The point of balance may be determined by connecting in series in the circuit, which is made and broken by the contact maker, the variable direct electromotive force and a telephone receiver in series with the electromotive force to be studied. When the direct electromotive force is equal but in opposition to the instantaneous alternating electromotive force at that instant when the circuit is closed, no current will flow through the circuit and the telephone receiver will be silent. A slight change in either the alternating or the direct motive forces will send a current through the circuit and will produce a click in the telephone receiver every time the circuit is closed by the contact maker. Of course, if desirable, a telephone receiver may be replaced by any sensitive connecting instrument.

The Oscillograph Method.

In the second method of tracing alternating-current waves an apparatus is used which has so little inertia that it is able to follow every variation in the current passing through its magnetizing coil. In the early types of the apparatus, the so-called oscillograph, a very small needle delicately suspended and carrying a tiny mirror is hung in the field, set up by a small coil. A strong beam of light is thrown upon the mirror and reflected from that to a sensitive photographic film. The needle follows every variation of current sent through the coil, so that if the sensitive paper be moved quickly but at the uniform rate across the line where the beam of light from the vibrating mirror plays, a trace will be left upon the film, which shows the variations in the current flowing through the coil. In this type of apparatus the great difficulty is

to obtain a needle so small that its inertia and its own period of vibration will not distort the form of the wave to be traced. This difficulty, however, has been prettily overcome recently by Professor Harris J. Ryan. The cathode rays thrown out from an exhausted tube when electrical oscillations are set up in it are deflected by a magnetic field. These rays are, of course, without inertia. By passing a ray through the magnetic field set up by the wave to be traced, the ray will vibrate through a path, its deflection at any instant being proportional to the intensity of the current in the coil. This gives an inertialess lever, which may be used to produce a permanent record of the form of the wave. The ray from this tube is allowed to impinge on a sensitive film if a record is desired, or upon a screen of some material which will respond to the excitation of the ray and become luminous when a visual image is sufficient. In the first case, since the photographic action of tubes which as yet have been used is small, an exposure lasting a few minutes is necessary. This, of course, gives a somewhat broader record than would be secured were there but one or two cycles recorded. However, it is a question whether the average curve secured when conditions are fairly constant is not as valuable as a record of a single cycle, which shows merely the conditions existing at the moment when that record was taken and not the average behavior of the circuit.

Value of Cathode-Ray Indicator.

The apparatus developed by Professor Ryan is suitable as well for commercial use as for laboratory experimentation, and its adaptability to high-frequency phenomena should make it of invaluable assistance in the study of telephone apparatus and the phenomena occurring during commutation in direct-current machinery, as we have here in general a frequency high compared to that of commercial alternating currents. The indicator itself is of such a nature that it can be used effectively even under commercial conditions, as it does not require the great refinements of location and protection to be found only in research laboratories. There seems to be no doubt that this instrument will find a most useful application in the study of electrical phenomena.

Tracing Current Waves.

When an electromotive-force wave is to be traced this electromotive force is generally used to cause a small current to flow through a circuit containing a high resistance, and the wave-form of this small current is traced and taken to be the same as that of the electromotive force. If a current wave is to be traced this is most conveniently done by sending the current through a simple resistance and the varying difference of potential across this resistance is traced, the curve being taken as similar to that of the current wave.

GROUNDED AND UNGROUNDED TRANSMISSION CIRCUITS.

The paper presented by Mr. J. S. Peck at a recent meeting of the American Institute of Electrical Engineers on "Grounded Transmission Circuits," should be of great value to engineers engaged in transmission work. Mr. Peck discusses the effect of grounding the line with various systems of transmission, showing where danger may arise and when this practice brings additional protection. The system offering the greatest number of ways of combining apparatus is the three-phase system, and it also happens that this is the one most generally used for power transmission for long distances at high voltages. In Mr. Peck's paper the effects of grounding the neutral with the various grouping of transformers are clearly shown, and the cases when danger may arise due to an accidental grounding or short-circuiting are pointed out.

Subject One of Real Importance.

During the discussion of this paper, several engineers who have had much experience with high-tension circuits took occasion to emphasize the fact that the possible dangers introduced by grounding pointed out by Mr. Peck were not imaginary, but were very real—a fact which shows that the paper deserves the study and attention of those interested in work of this character.

Danger to the Telephone Line.

Mr. Peck also points out the danger to the telephone system introduced by grounding any part of the line, a danger which is entirely distinct from that which may threaten transformers. The telephone system is to-day an essential part of every transmission line, and any construction which may jeopardize this should receive careful consideration before being adopted.

MODERN VIEWS ON MATTER—THE REALIZATION OF A DREAM.[1]

BY SIR WILLIAM CROOKES.

(Concluded.)

Many lines of argument and research tending toward the same point give trustworthy data by which to calculate the masses and velocities of these different particles. I must deal with big figures, but big and little are relative, and are only of importance in relation to the limitations of our senses. I will take as the standard the atom of hydrogen gas—the smallest material body hitherto recognized. The mass of an electron is 1/700th of an atom of hydrogen, or 3×10^{-26} grammes, according to J. J. Thomson, and its velocity is 2×10^{9} centimetres per second, or two-thirds that of light. The kinetic energy per milligramme is 10^{17} ergs, about 3,500,000 foot-tons. Becquerel has calculated that one square centimetre of radioactive surface would radiate into space one gramme of matter in 1,000,000,000 years.

The positively electrified masses or ions are enormously great in comparison with the size of the electron. Sir Oliver Lodge illustrates it thus: If we imagine an ordinary sized church to be an atom of hydrogen, the electrons constituting it will be represented by about 700 grains of sand, each the size of an ordinary full-stop (350 positive and 350 negative) dashing in all directions inside, or, according to Lord Kelvin, rotating with inconceivable velocity. Put in another way, the sun's diameter is about 1,500,000 kilometres, and that of the smallest planetoid about twenty-four kilometres. If an atom of hydrogen be magnified to the size of the sun, an electron will be about two-thirds the diameter of the planetoid.

The extreme minuteness and sparseness of the electrons in the atom account for their penetration. While the more

[1] An address delivered before the Congress of Applied Chemistry at Berlin, June 5, 1903.

massive ions are stopped by intercollisions in passing among atoms, so that they are almost completely arrested by the thinnest sheet of matter, electrons will pass almost unobstructed through ordinary opaque bodies.

The action of these emanations on phosphorescent screens is different. The electrons strongly affect a screen of barium platinocyanide, but only slightly one of Sidot's zinc sulphide. On the other hand, the heavy, massive, non-deflectable positive ions affect the zinc sulphide screen strongly, and the barium platinocyanide screen in a much less degree.

Both Rœntgen rays and electrons act on a photographic plate and produce images of metal and other substances enclosed in wood and leather, and throw shadows of bodies on a barium platinocyanide screen. Electrons are much less penetrating than Rœntgen rays, and will not, for instance, show easily the bones of the hand. A photograph of a closed case of instruments is taken by radium emanations in three days, and by Rœntgen rays in three minutes. The resemblance between the two pictures is slight, and the differences great.

The power with which radium emanations are endowed of discharging electrified bodies is due to the ionization of the gas through which they pass. This can be effected in many other ways; thus, ionization is communicated to gases faintly by the splashing water, by flames and red-hot bodies, by ultra-violet light falling on negatively electrified metals, and strongly by the passage of Rœntgen rays.

According to Sir Oliver Lodge's electronic theory of matter, a chemical atom or ion has a few extra negative electrons in addition to the ordinary neutral atom, and if these negative electrons are removed it thereby becomes positively charged. The free electron portion of the atom is small in comparison with the main bulk, in the proportion in hydrogen of about 1 to 700. The negative charge consists of super-added or unbalanced electrons—one, two, three, etc., according to the chemical valency of the body—whereas the main bulk of the atom consists of paired groups, equal positive and negative. As soon as the excess electrons are removed, the rest of the atom, or ion, acts as a massive positively charged body, hanging tightly together. In a high vacuum the induction spark tears the components of a rarefied gas apart; the positively charged ions, having great comparative density, are soon slowed down by collisions, while the electrons are driven from the negative pole with an enormous velocity depending on the initial electromotive force and the pressure of gas inside the tube, but approaching, at the highest exhaustions, half that of light.

It is recognized that electrons have the one property which has been regarded as inseparable from matter—nay; almost impossible to separate from our conception of matter—I mean inertia. Now, in that remarkable paper of J. J. Thomson's published in 1881, he developed the idea of electric inertia (self-induction) as a reality due to a moving charge. The electron therefore appears only as an apparent mass by reason of its electro-dynamic properties, and if we consider all forms of matter to be merely congeries of electrons, the inertia of matter would be explained without any material basis. On this view the electron would be the "protyle" of 1886, whose different groupings cause the genesis of the elements.

There is one more property of the emanations of radium to bring before your notice. I have shown that the electrons produce phosphorescence of a sensitive screen of barium platinocyanide, and the positive ions of radium produce phosphorescence of a screen of zinc blende.

If a few minute grains of radium salt fall on the zinc sulphide screen the surface is immediately dotted with brilliant specks of green light. In a dark room, under a microscope with a two-third-inch objective, each luminous spot shows a dull centre surrounded by a diffused luminous halo. Outside the halo the dark surface of the screen scintillates with sparks of light. No two flashes succeed on the same spot, but are scattered over the surface, coming and going instantaneously, no movement of translation being seen.

If a solid piece of a radium salt is brought near the screen, and the surface examined with a pocket lens magnifying about twenty diameters, scintillating spots are sparsely scattered over the surface. Bringing the radium nearer the screen the scintillations become more numerous and brighter, until when close together the flashes follow so quickly that the surface looks like a turbulent luminous sea. When the scintillating points are few there is no visible residual phosphorescence, and the successive sparks appear "atoms of intensest light," like stars on a black sky. What to the naked eye seems like a uniform "milky way," under the lens becomes a multitude of steller points, flashing over the whole surface.

In a vacuum the scintillations are as bright as in air, and being due to interatomic motion they are not affected by extremes of low temperature; in liquid hydrogen they are as brilliant as at the ordinary temperature.

A convenient way to show these scintillations is to fit the blende screen at the end of a brass tube with a speck of radium salt in front about a millimetre off, and to have a lens at the other end. I propose to call this little instrument the "spinthariscope," from the Greek word σπινθαρίς, a scintillation.

It is probable that in these phenomena we actually witness the bombardment of the screen by the positive ions hurled off by radium with a velocity of the order of that of light. Each particle is rendered apparent only by the enormous extent of lateral disturbance produced by its impact on the sensitive surface, just as individual drops of rain falling on a still pool are not seen as such, but by reason of the splash they make on impact, and the ripples and waves they produce in ever-widening circles.

Indulging in a "scientific use of the imagination," and pushing the hypothesis of the electronic constitution of matter to what I consider its logical limit, we may be, in fact, witnessing a spontaneous dissociation of radium—and we begin to doubt the permanent stability of matter. The chemical atom may be actually suffering a katabolic transformation; but at so slow a rate that supposing a million atoms fly off every second, it would take a century for weight to diminish by one milligramme.

It must never be forgotten that theories are only useful so long as they admit of the harmonious correlation of facts into a reasonable system. Directly a fact refuses to be pigeon-holed and will not be explained on theoretic grounds, the theory must go, or it must be revised to admit the new fact. The nineteenth century saw the birth of new views of atoms, electricity and ether. Our views to-day of the constitution of matter may appear satisfactory to us, but how will it be at the close of the twentieth century? Are we not incessantly learning the lesson that our researches have only a provisional value? A hundred years hence shall we acquiesce in the resolution of the material universe into a swarm of rushing electrons?

This fatal quality of atomic dissociation appears to be universal and operates whenever we brush a piece of glass with silk: it works in the sunshine and rain-drops, and in the lightnings and flame; it prevails in the waterfall and the stormy sea. And although the whole range of human experience is all too short to afford a parallax whereby the date of the extinction of matter can be calculated, protyle, the "formless mist," once again may reign supreme, and the hour hand of eternity will have completed one revolution.

The Use of Electric Power in Plowing.

Some New Applications of Electricity to Cultivating Farms.

By Emile Guarini.

ANIMAL and steam power no longer suffice for agriculture. There is a need for an agent assuring more rapid working and greater economy and efficiency, a need which is supplied by electricity. The practical application of electricity to tilling has not come about without many trials and tests of various methods. The most simple system is that in which the plow is provided with wheels driven by a motor, but it was quickly found that this system was not free from serious objections. The first of these is the placing of heavy apparatus upon a plow which must travel over a field offering great resistance. The second, and the principal objection to this method, is the difficulty of supplying power to the motor, as the feeding cables must be displaced continually to follow the motion of the plow.

These disadvantages are met also in another system, although in this they are not as serious. In this system the motor draws the plow across the field by means of a chain, Fig. 1, and not by driving the wheels of the carriage. The chain is stretched across the field, and is displaced little by little parallel to the furrows. The mechanical efficiency of these systems is not satisfactory, and a better arrangement has been sought. This has resulted in placing the motor on a carriage provided with a drum, on which is wound up the cable or chain which draws the plow. There are two varieties of this system—that having one motor and that having two. The first, Fig. 2, B. C. D.,—that with one motor—is the most economical, but it can work only in soft ground. In this system the motor carriage is placed on one side of the field, and draws the plow by means of a cable passing over a pulley which is anchored at the other side of the field. The other end of this cable is carried back to the motor carriage and wound upon a second drum which serves to move the plow in the opposite direction.

In the second variety of this system, Fig. 2, A, two motor carriages are employed. This system is more rapid than the one just described, and is capable of working difficult, compact earth. In this system the second motor carriage replaces the anchor of the first, and the plow is drawn across the field, first by one motor and then by the other.

Having explained the differences between the methods, it will be well to examine the details of application which have been made, and to note the intrinsic value of each system. In order to appreciate that value it will be necessary to examine carefully the results. Attention should also be paid to the time necessary for operation, to the weight of earth

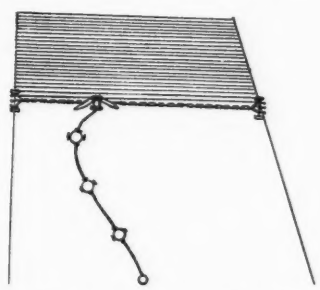


FIG. 1.—ELECTRIC PLOWING BY MEANS OF CHAIN.

cultivated, to the consumption of coal and loss of energy, the cost of operation, including that of coal, water, oil, attendance, repairs, interest on the capital and depreciation of the material. Figures can rarely be obtained on all these points, and therefore this article will cover the performance of each system without entering into a discussion of the comparative merits.

One system developed in Chicago deserves mention. An electric automobile was used to draw an ordinary plow, or any other apparatus. The second invention of that kind was the apparatus constructed by M. P. Taillade, the engineer of Arts and Métiers. This plow or cultivator consisted simply of an ordinary plow, on which was mounted an electric motor driving wheels. The motor operated, in addition, a series of knives on an axle, which worked the earth. The objections inherent with this type of apparatus have been indicated above, and it will not be necessary to return to it.

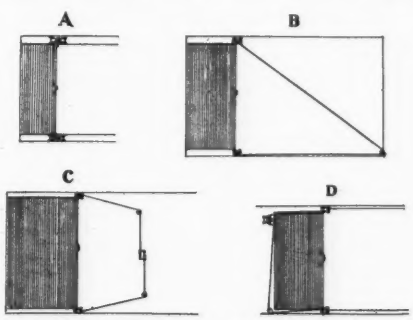


FIG. 2.—ONE AND TWO MOTOR SYSTEMS OF ELECTRIC PLOWING.

The house of Zimmermann, of Halle-sur-Saale, has owned a towing system for some time. The motor is mounted on the frame of the plow, and carries fixed to its shaft a toothed drum, the teeth of which gear in the links of a chain. The latter is fixed at each end of the field, Fig. 1, by anchors which can be disengaged by one man and moved for each furrow. The anchors are mounted on wheels, and are raised from the ground by a lever. Their weight is thirty-five kilogrammes only. When the end of a furrow is reached the plow is raised, turned and restarted by the action of a switch which controls the current in the motor. This instrument is regulated by the apparatus for carrying the conductor. To feed the current to the motor there are two cables mounted on small carriages similar to those employed for irrigating pipes. The two cables are insulated, and wind and unwind on a drum placed on the plow. There are a number of models of this plow, differing in the number of plowshares. The least expensive (7,500 francs) has two shares. It is suitable particularly for small work, and requires a current of 110 volts and sixty to eighty amperes. The furrows thus made are from twenty-five to twenty-eight centimetres deep, and sixty centimetres wide. This apparatus can also work the subsoil plows which follow the plow and penetrate to a depth of forty centimetres. In tests made in 1895, in a heavy, tough clay, the furrows had a total width of sixty centimetres and a depth of twenty-four centimetres. The dynamometer showed a pull of 600 to 700 kilogrammes, giving about forty-five kilogrammes per square decimetre. The speed was at no time less than ninety metres per minute. The energy consumed was eight horse-power, and the loss was four horse-power.

For large work a model with four plows is most suitable. It requires more energy, but makes it possible to cultivate from four to five hectares to a depth of thirty-five centimetres in ten hours. The cost of the work is 25.65 francs per hectare cultivated, while it is 62.50 when oxen are used. The inconveniences due to the weight of the cable have been mentioned above.

Turning now to apparatus of more in-

terest from the practical viewpoint, one of the best known in France has been developed by M. Felix Prat. In his arrangement an electric motor drives, through gearing, two drums turning in opposite directions, one for taking the plow out and the other for returning it. Brakes regulate the speed of the drums, and prevent the cable from unrolling without maintaining a certain tension. The system, while interesting, has not given entirely satisfactory results.

Another model of the electric plow operated from a drum has been developed by the house of Eckert. In this the drum is placed perpendicularly to the position it usually occupies, in order that the pulley which carries the cable from the upper to the lower part of the windlass may be done away with.

The windlass plows considered up to this point are single-acting. Those due to Herr Brutschke, of Berlin, Fig. 3, are double-acting—that is to say, they work going and returning. The great difficulty in this system is that the cable for going, as well as that for returning, is subjected to the same pull. For this reason it is necessary that the return pulley be solidly fixed, while, on the other hand, for quick working it should be relatively movable. This pulley is placed on a four-wheeled carriage, the wheels of which are furnished with a cutting flange for the purpose of increasing the lateral thrust on the ground. To this carriage is attached a sort of prong anchor which penetrates deeply into the ground. Herr Brutschke makes use of the rotation of the pulley during the period when the plow is returning toward the windlass to shift the anchor. When the cable passes over the pulley, without exerting much tension, the anchor is raised by means of a chain and the carriage displaced a certain distance automatically. Immediately the anchor sinks to the ground, and when the cable reverses the increased pull on the latter forces the anchor into the ground. The Brutschke apparatus has been used at Grotz-Behnitz and at Sillium, Germany.

The house of A. Borsig, Berlin, builds a type of plowing apparatus which is worth examination. The motor is fed by movable connections branched from fixed conductors. A conductor 300 metres long and a cable of the same length enable the machine to cultivate 300 hectares. The apparatus includes a controlling carriage, an anchor carriage and a plow which travels between the two carriages, turning five furrows at a time. The controlling carriage is provided with an alternating-current motor of forty horsepower, switches, interrupters and gearing which enables the motor to shift the carriage. The anchoring carriage carries an anchor and a drum about which is coiled the drawing cable. This carriage has a grooved pulley, over which passes the traction cable. This pulley is mounted on a guide and connected to the anchors by a chain. There are four anchors suspended from a small windlass which allows them to be raised completely for shifting the carriage. When the plow is moving toward the motor, the slack side of the traction cable drives a gear which lifts the anchors and moves the anchor carriage into the position necessary for the following furrow.

The towing system due to Colonel Brussiere has been used at Cureyras, in Algeria. An advantage of this system is that the towing cables are wound only to the depth of one layer, which causes less wear; but this advantage is at the expense of a weight of 20,000 kilogrammes.

La Société Helios, of Cologne, also builds electric plows equipped both with one motor and an anchoring carriage or with two motors. The one-motor system includes a motor carriage and an anchoring carriage. It is interesting to remark that electrical tillage began with the use of two motors. Thus, the first tests—those of Chrétien and Félix, at Sermaize, in 1879—were made by this means. In spite of the defective construction of the apparatus employed the efficiency was fifty per cent. The power used was eight horse-power at the generator and four horse-power at the receivers. The plow traversed from fifty to seventy metres per minute, and worked twenty square metres with a width of furrow of twenty-seven and one-half centimetres, and a depth of twenty centimetres.

Some years later, in 1885, a double trailing system was again used in the Proforiano tests in Frioul, the estate of Comte Vittorio Asarta. Three hectares were cultivated in ten hours, making six furrows twenty-two centimetres deep.

FIG. 3.—BRUTSCHKE APPARATUS FOR PLOWING. THE MOTOR IS DOUBLE-ACTING AND ALSO SHIFTS THE CARRIAGE FOR A NEW SET OF FURROWS.

The plow traveled at the rate of seventy metres per minute. It was provided with three shares and cultivated a total width of ninety centimetres.

In addition to the tilling the electricity is used to drive various mines and to light the farms and streets of the village.

An interesting installation is that on the Diedrichshagen farm. As the fields are distant three and one-half kilometres from the farmhouse, it is necessary to use alternating currents for transmission. The overhead line is composed of three wires of four millimetres cross-section. The power transmitted is thirty-seven horse-power. The voltage is 2,200, but this is transformed on the ground to 220. The work was done with two electrical windlasses and a metallic cable. The efficiency is about seventy-five per cent, each windlass representing a power of twenty-eight horse-power. The plow has four shares and makes 300 metres in six minutes. The furrows have a total width of 1.8 metres and a depth of thirty centimetres. At the end of the furrow the plow is reversed in not more than 1.5 minutes. In one hour the plow makes eight journeys and cultivates 4,350 square metres. The cost is only 0.09 mark per horse-power, making for thirty-seven horse-power, during ten hours, thirty-three marks. All expenses included, the saving realized is fifty per cent.

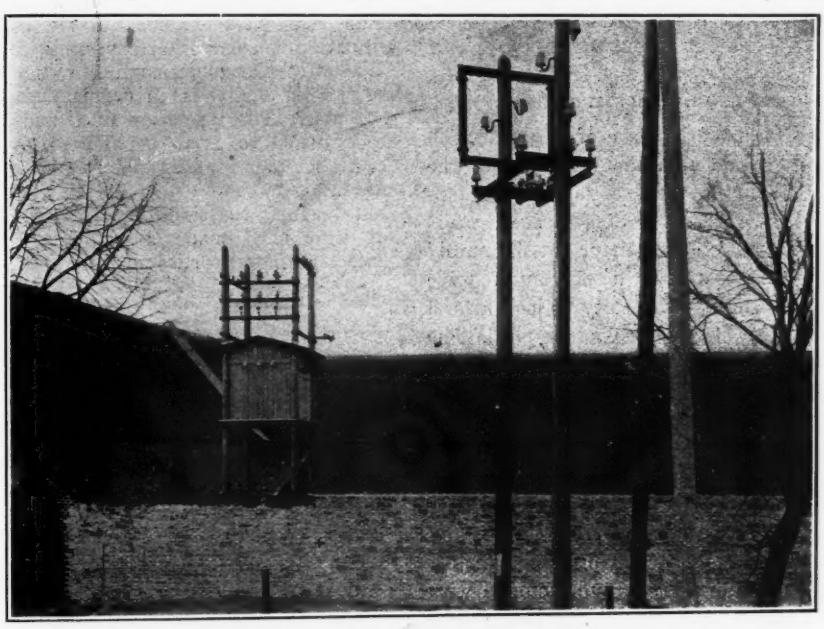


FIG. 5.—TRANSFORMER SUBSTATION AT CROTTORF, SUPPLYING POWER FOR ELECTRIC PLOWING.

The Dolberg apparatus makes use of a metallic cable and a windlass separated from the motor. It is placed on two large metal beams carrying the slide rails of the motor, and is driven from the motor by means of a belt. This apparatus is, unfortunately, not easily shifted about. The Forster apparatus is faulty, since the windlass is placed too high up. The Siemens & Halske apparatus makes use of a motor fed by an insulated cable which it unwinds from a drum. The motor drives the wheels of the windlass or the cable drum and shifts the carriage. This has the advantage that with only three men—one at each windlass and one on the plow—the work can go on with speed and regularity, due to the fact that, without stopping, the man at the windlass can manipulate the plow or shift the windlass. The disadvantages of the system are the great weight of the apparatus (ten and one-half tons) and the deterioration of the cable, due to irregular winding and unwinding.

The two motor models have the disadvantage over those with one motor of being more costly and of requiring two windlasses and a double feeding system; but the amount of work accomplished in the same time is considerably more. This expense is diminished by Forster's arrangement in Fig. 4, which eliminates half of the feeding system. The current in this arrangement is supplied by a copper cable carried on special poles. This is connected to one of the motors. From here the current is passed along the towing cable to the second motor, when it returns to the generator by a second feeder, requiring two feeding cables only in place of four.

As we have seen above, these electric plows, though some are more perfect than others, all have the advantage of easy displacement, of regular and rapid operation, of easy setting up, and of operating at a great distance from the source of supply (Fig. 5), giving at the same time a mean efficiency of fifty per cent.

Specialists are not in agreement on the cost of plowing in this way. Thus, agriculturist Brutschke estimates that it is possible to cultivate four hectares in ten hours, with furrows thirty-five centimetres deep, and using only ninety kilo-

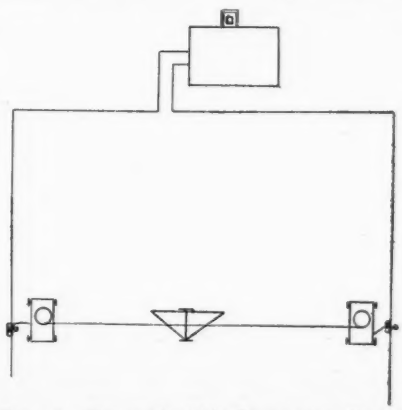


FIG. 4.—FORSTER'S TWO-CONDUCTOR SYSTEM OF ELECTRIC PLOWING.

watt-hours. The cost of the kilowatt-hour is given as 0.29 franc. At this rate, electrical tilling should cost, everything included, 25.89 francs per hectare. Mr. Ringelmann, a French agriculturist, questions this figure, because the kilowatt-hour should be estimated, according to him, at 0.36 franc. This would increase the expense to 38.62 francs per hectare. If it is possible to cultivate sixty hectares per day, instead of four, the expense would be only 25.75 francs per hectare.

Whatever the expense, it is certain that the saving effected is considerable, and that there are practical advantages in electrical tilling, particularly for large estates.

State Laws Affecting Automobiles.

The American Automobile Association has issued a most useful little book giving the text of the laws affecting automobiles in the state of New York, New Jersey, Pennsylvania, Connecticut, Massachusetts, Rhode Island, Vermont, Maine and Delaware. In addition to the text of the laws a valuable feature of the pamphlet is the digests of the various state laws. This makes it an easy matter to reach an understanding of the purposes of the laws and the restrictions imposed by the different state authorities. The book is of convenient size for carrying in the pocket, and every owner of an automobile should possess one. The American Automobile Association is distributing these books to the various club members of the association, as well as to individual members. It is proposed at a later date to issue a second pamphlet embracing the automobile laws of the western states.

THE CATHODE-RAY ALTERNATING-CURRENT WAVE INDICATOR.[1]

BY HARRIS J. RYAN.

During the past three years I have had considerable experience in the use of the Braun type of cathode-ray tube to determine the character of rapidly changing electric currents. In this experience I developed the following

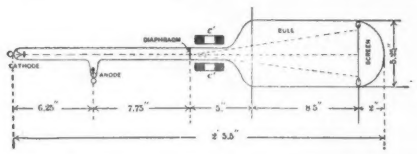


FIG. 1.—TUBE, SHOWING POSITION OF ONE PAIR OF COILS.

method for using this form of tube as an alternating-current wave indicator. By means of the method this instrument fills much the same sort of a want in the detail study of many alternating-current phenomena as does the indicator in the study of the cyclic performance of steam in the steam engine.

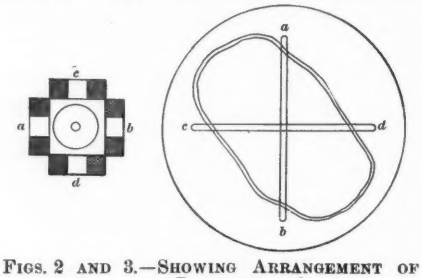
I have found the method so convenient and satisfactory in a large class of work compared with other and more usual methods that I am confident that many members of the Institute will find its employment often convenient and most useful in their own work.

DESCRIPTION OF THE METHOD.

The usual form of cathode-ray tube employed for indicating alternating currents is shown in Fig. 1. The cathode and anode are connected to the negative and positive conductors respectively of a motor-driven Wimshurst electrostatic machine. A current of about 0.0005 ampere is set up in so doing and the cathode rays are driven forward through the tube, striking the glass diaphragm which is opaque to them. All of the rays are stopped at this diaphragm except those which pass through a small aperture at its centre. This pencil of rays continues until they strike the screen where they cause a brilliant spot of fluorescent light. The screen is of mica spread with white powder that powerfully fluoresces when struck by the cathode ray.

Comparatively weak magnetic fields will cause large deflections to the ray. Thus if a continuous current be passed through the coils, c' c'', mounted just beyond the diaphragm as shown in Fig. 1, of sufficient strength in regard to the number of turns in the coils so as to produce a magneto-motive force of about fifty ampere-turns, the ray will be deflected well to one side of the centre of the tube, causing a corresponding displacement of the spot of light on the screen to the point marked +. Such deflection is due to the magnetic field set up across the cathode ray by the current in the coils. When the current ceases the spot of light produced by the ray returns to its normal position at 0. If the current is set up in an opposite direction, the spot of light will shift on the screen to the point marked —. When an alternating current having the same maximum value is substituted for the continuous current, the spot of light will vibrate between the + and — positions, and owing to the persistence of vision will appear as a band of light.

By looking at the screen as seen reflected from a revolving mirror, the spot of light actuated by an alternating current will trace a wave that will have the



FIGS. 2 AND 3.—SHOWING ARRANGEMENT OF COILS AND DIAGRAM OF CARD.

same form as the wave of current which is passed through the coils due to the fact that the cathode ray has no appreciable inertia. Some investigators have revolved the mirror synchronously and thus obtained a stationary wave which is most satisfactory to look at and which may be readily photographed. The synchronous driving and satisfactory adjustment of the revolving mirror involve expensive apparatus that is cumbersome and tedious in manipulation; to avoid the use of this apparatus I have devised the following method:

Reference is here made to Figs. 2 and 3. Two sets of coils are applied just beyond the diaphragm and mounted with their axes at right angles and in the same plane as shown in Fig. 2. The coils having the axis a b set up a horizontal field and which when established with alternating currents will produce the vertical motion of the spot of light producing a luminous band on the screen shown at a b in Fig. 3. Similarly, the coils having the axis c d produce the horizontal motion of the spot and the band c d. When the alternating currents are set up simultaneously through both sets of coil, the spot of light will be subject to both motions tracing the card shown by the broken line.

In order that definite results may be obtained, only one of the wave-forms of the two currents may be unknown; the other must be of known form. The most suitable known form is that of a true sine wave. To secure a true sine wave of current with ample accuracy for all practical purposes, I have employed the following arrangement of inductance and capacity. Referring to Fig. 4, AC are leads from an alternating source of unknown pressure wave-form supplying the current to an apparatus at M that is to be observed. The circuit through M leads through one set of coils mounted at c_1 c_1, so as to give a motion of the cathode ray that is proportional to the instantaneous values of the current through M. The current that produces the standard sine wave motion of the cathode-ray tube passes through the coils c_2 c_2 with their axes at right angles and in the same plane of the axis of the coils c_1 c_1. This current is obtained from the source having an unknown pressure wave-form at a' c'. It passes from c' through the single path L′ and the paths C and L″ in multiple, and finally to the source at a'. The coils c_2 c_2 are connected in the branch L″. L′ and L″ are inductive reactions made by mounting coils on straight laminated iron cores. The ohmic resistances are made as low as is ordinarily convenient and possible compared with the corresponding values of the reactances. C is an ordinary paper condenser. The reactances of C and L″ are adjusted so as to be approximately equal and, therefore, so that resonance is established to some extent due to the exciting current that is set up through L′. All who have made a study of the characteristic properties or behaviors of

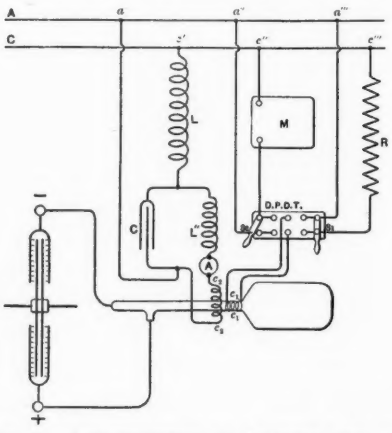


FIG. 4.—ARRANGEMENT OF CIRCUITS FOR AN ARC CATHODE-RAY INDICATOR.

the harmonic elements or component irregularities in relation to inductance and capacity will note at a glance the powerful action that this circuit will exert in expurgating the current that passes the branch L″ A c_2 c_2 of all irregularities causing it to have a simple sine wave-form.

(To be concluded.)

[1] A paper presented at the twentieth annual convention of the American Institute of Electrical Engineers, Niagara Falls, N. Y., July 2, 1903.

GROUNDED AND UNGROUNDED TRANSMISSION CIRCUITS.[1]

BY J. S. PECK.

The question of grounding or not grounding the neutral and of the best method of connecting transformers is one of great importance, and it is the object of this paper to point out some of the conditions, both normal and abnormal, which arise with different systems of connections with and without grounded neutral.

By the grounding of the neutral point of a transmission system it is sought:

1. To limit the strain from line wires to ground.

2. To limit the strain between high-tension and low-tension windings of the transformers, also between high-tension windings and iron core.

Consider first the case of a single-phase transformer ungrounded, with high-tension and low-tension voltages taken for convenience as 10,000 and 1,000, respectively. There is evidently a maximum strain of 10,000 volts from one high-tension line wire to the other. If the circuits are insulated and symmetrical there will be a strain of 5,000 volts from each line wire to ground, and from each extremity of the high-tension winding to the low-tension winding and to the iron core.

If, however, the circuits are not symmetrical, the full strain will not be equally divided, and if in an extreme case one high-tension wire is grounded there will be a strain of 10,000 volts from the other line wire to ground; similarly, if one extremity of the high-tension winding be connected to the low-tension winding or to the core, there will be a strain of 10,000 volts from the other extremity of the high-tension winding to the low-tension winding or to the core.

The actual strain between adjacent high-tension and low-tension windings is equal to the high-tension voltage plus or minus the low-tension voltage, depending upon the arrangement and connection of the coils; but as the low-tension voltage is usually a small percentage of that of the high-tension, it is customary to assume that the strain between windings is equal to that of the high-tension voltage alone.

If the middle or neutral points of high-tension and low-tension windings are grounded, the iron core being also grounded, then as long as the circuits are in balance the voltage strains will be the same as with the windings ungrounded and balanced; but in case of a ground on either high-tension or low-tension line, or in case of a connection between high-tension and low-tension windings, a portion of the windings will be short-circuited. This will, in general, blow fuses or circuit-breakers, thus cutting the transformer out of service; or the voltage of the system will be lowered to such an extent as to call attention to the trouble.

Thus, on a single-phase transmission system, the grounding of the neutral point of primary and secondary windings will limit the strain from line to ground, and from either extremity of high-tension to low-tension and iron to approximately one-half the normal voltage of the system. If the neutral of only one winding is grounded, the strain from this winding to ground will be limited to approximately one-half of its normal voltage, but the strain from the ungrounded winding to ground and to iron and to the grounded winding will not be thus limited.

In considering other systems, the voltage strains between primary and secondary will not be mentioned, as these strains are easily calculated when the voltage on the transformers and the strain to ground is known. A short-circuit on a system will be assumed to cut out the transformers.

TWO-PHASE, FOUR-WIRE SYSTEM.

The two-phase, four-wire system is practically a double single-phase system, and the conditions for grounded and ungrounded neutral will be the same as for single-phase.

TWO-PHASE, THREE-WIRE SYSTEM.

The voltage across the two outside wires is 1.4 that between the middle and either outside wire. A ground on the middle wire will give a strain of 10,000 volts between each outside wire and ground, while a ground upon an outside wire will give a strain of 10,000 volts from middle wire to ground, and of 14,000 volts from the other outside wire to ground.

The neutral point for this system may be obtained from the middle point of an auto-transformer connected across the transformer windings. In this case, a ground upon any line wire will cause a short-circuit on the transformers, thus limiting the strain to ground to approximately 0.7 normal line voltage.

In general, the method of obtaining the neutral point by means of auto-transformers is not feasible on high-tension systems on account of the comparatively great cost of an auto-transformer wound for the high-tension voltage, and it will not be further considered in this discussion.

THREE-PHASE, DELTA SYSTEM.

With this system the strain from any line wire to ground is, with the system in perfect balance, fifty-eight per cent of the line voltage. In case of a ground on any line wire, the two remaining wires are raised to full line potential above the ground.

With this connection one transformer may be cut out, leaving two connected in V, and the above conditions will not be changed.

THREE-PHASE "V" SYSTEM.

With transformers connected in V, the strains will be the same as when connected in delta.

THREE-PHASE, "T" AND TWO-PHASE, THREE-PHASE SYSTEM.

With either the T or two-phase-three-phase connection the voltage strains with ungrounded neutral are the same as for the delta system. The neutral point may, however, be obtained from the teaser winding, in which case a ground upon any line wire will short-circuit portions of the windings.

With the three-phase T and two-phase-three-phase connection the grounding of the neutral limits the voltage between line and ground to fifty-eight per cent of normal.

STAR SYSTEM.

With transformers connected in star the conditions are very similar to those where two transformers are connected with primary windings in series and also the secondaries in series.

The total line voltage will divide with approximate equality between the two transformers. Between line wires and ground there will exist the same strain as with a single transformer, having the same total voltage; but if one transformer be short-circuited, the full voltage will be concentrated upon the other transformer so that the internal voltage strains on this transformer will be doubled and its iron loss greatly increased, though the strain from line wires to ground may be the same as before.

If the series connection between the two transformers be grounded, and a ground occur on either line wire, the transformer connected to this wire will be short-circuited and the other transformer will take the full voltage of the circuit and the ungrounded wire will be raised to full line voltage above ground.

Unless the leakage current of the transformer working at double voltage is suffi-

[1] Abstract of paper read at annual convention of the American Institute of Electrical Engineers, Niagara Falls, July 1, 1903.

cient to open the circuit, the transformer may continue to operate indefinitely under the above conditions provided it does not break down, due to excessive heating or to the double voltage strains to which it is subjected.

In the case of a star-connected group of transformers with the neutral point of the primary and of the secondary, and also that of the generator, grounded, no excessive voltage can occur on any transformer, and the strain from any line wire to ground is limited to fifty-eight per cent of full line voltage, for a ground on any line or a short-circuit in any transformer will short-circuit the generator.

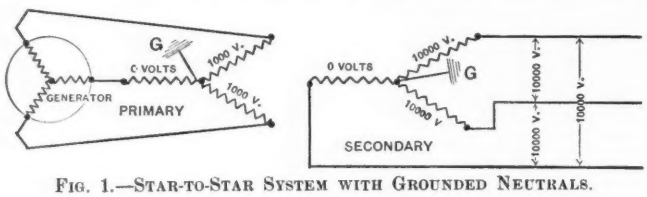


FIG. 1.—STAR-TO-STAR SYSTEM WITH GROUNDED NEUTRALS.

Fig. 1 shows the same system of connections but with the generator ground omitted. In this case a ground upon the primary or secondary line will short-circuit one transformer of the group and the two remaining ones will be operated at seventy-three per cent above normal potential; also the strain between the ungrounded wires and the line will be that due to the full line voltage.

Thus for a star-connected system the grounding of the neutral points is of no value in limiting the voltage strains on the system unless the neutral point of the generator be also grounded; in fact, the grounding of the transformers without the grounding of the generator increases the chance for trouble, since a ground upon any line wire increases by seventy-three per cent the voltage of two of the transformers.

STAR-TO-DELTA SYSTEM.

With a star-to-delta system no excess voltage can be obtained on any transformer, and not more than full voltage strain to ground, provided the delta remains closed; but with the delta open at one point and a short-circuit on one transformer (Fig. 2), the voltage on the two remaining ones will be increased seventy-three per cent and across two sides of the delta there will be three times normal voltage. Thus, on a 10,000-volt circuit, 30,000 volts may be obtained in case a transformer is short-circuited and cut out of the delta.

This excess voltage across the two sides of the delta is due to the fact that a short-circuit on the star changes the angular position of the voltages from 120 degrees to sixty degrees, which in turn changes the angular position in the delta from sixty degrees to 120 degrees.

DELTA-TO-STAR SYSTEM.

With this system it is impossible to obtain voltages higher than normal upon any transformer or between any two line wires. A short-circuit in one transformer may, however, cut it out of the delta but leave the star-connection intact. Two of the transformers operate at normal potential, with normal potential between two of the line wires, but with fifty-eight per cent of normal between the other wires.

STAR-TO-DELTA, RAISING. DELTA-TO-STAR, LOWERING.

In Fig. 3 is shown a transmission system with raising transformers connected star-to-delta, and lowering transformers connected delta-to-star. The neutral points of the low-tension windings of both raising and lowering transformers are grounded, and there is a ground on one low-tension lead which short-circuits one transformer. The high-tension side of this transformer is cut out of the delta. The voltage across the other transformer is increased seventy-three per cent, and the phase relation changed from 120 degrees to sixty degrees, the voltages being as shown in Fig. 2. On the lowering delta, three times normal voltage is impressed on one transformer and seventy-three per cent above normal voltage on the other two. The voltages obtainable across the star on the lowering transformers are readily understood from the figure. It will be noted that across one phase there is normal voltage and across the other two phases 2.7 times normal voltage. It is probable that a transformer subjected to three times normal voltage would take so large a leakage current as to blow fuses.

With this system of connection, grounding the neutral point of the star without a ground upon the neutral point of the generator is of no use in preventing unequal and excessive strains on the transformers and from line wires to ground. Should the delta on the raising transformers be kept closed, it is obvious that a short-circuit on any raising transformer would short-circuit the generator, but the above condition is one which might very possibly occur where switches or fuses are placed inside the delta.

DELTA-TO-STAR, RAISING. STAR-TO-DELTA, LOWERING.

Fig. 4 shows approximately the voltages and phase angles obtained when one raising transformer is short-circuited and cut out of the delta, but with the star-connection intact. The voltages obtained on the lowering delta will be approximately those shown. It will be noted that this delta has been twisted far out of its normal form, though the voltage on no transformer has been raised above normal and on the lowering transformer all voltages are below normal.

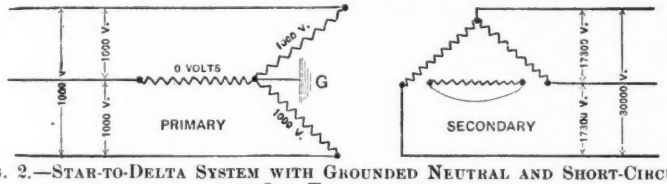


FIG. 2.—STAR-TO-DELTA SYSTEM WITH GROUNDED NEUTRAL AND SHORT-CIRCUIT ON ONE TRANSFORMER.

Fig. 5 shows the same connection but with one transformer short-circuited and cut out of the delta. The voltage across one of the remaining transformers is increased seventy-three per cent, while that across the other remains normal. The voltage across the open side of the second-

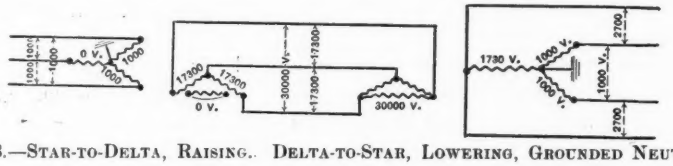


FIG. 3.—STAR-TO-DELTA, RAISING. DELTA-TO-STAR, LOWERING, GROUNDED NEUTRALS.

ary delta is increased 165 per cent above normal; that on one, seventy-three per cent above normal and on the other it is normal.

If the neutral points of raising and lowering transformers are grounded the abnormal conditions shown in Figs. 4 and 5 can not be obtained, for in this case, with the lowering delta closed, as in Fig. 4, the fuses will be blown when a lowering transformer is short-circuited; and with the delta open, as shown in Fig. 5,

a short-circuit in the lowering transformer will short-circuit the generator.

It is obvious that a large number of combinations of raising and lowering transformers in addition to those given above may be obtained.

Resonance — The abnormal voltages given above are those which are obtained from the generator pressure through direct transformation. Mr. Blackwell, in his paper, "Star or Delta-Connection of Transformers," has called attention to another cause which may produce abnormal voltages, *i. e.*, resonance. This is particularly liable to occur when a high inductance, such as the winding of an idle transformer, is in series with a large capacity, such as that of a transmission line.

In addition to the combinations given above there are the two-phase-three-phase, three-phase V and three-phase T-connections which may be used at either the raising or lowering ends. When used for raising transformers, these combinations will deliver their proper voltages to the line provided the proper voltages are impressed on their primary terminals, as it is impossible by short-circuiting one transformer to raise the voltage of the other.

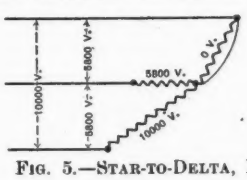
When used as lowering transformers these combinations will supply to the secondary circuits, voltages of proper amount and bearing the proper phase relation to each other, provided the voltages impressed on the primary side are of proper amount and proper phase relation to each other. If, however, the voltages applied to the primary are distorted then the voltages delivered by the secondaries will be correspondingly distorted.

Grounded Neutrals—It will be noted that in many cases the grounding of the neutral points of a transmission system limits the voltage strain to ground and the voltage which may be obtained across any transformer, and in such cases grounding would seem advisable. This is notable in the case of the star-system with grounds on transformer and generator neutrals. There is, however, a danger arising from this grounding which should be carefully considered. In case of trouble on the circuits, current may flow through the ground to the neutral; in thus flowing it will naturally take the path of least resistance, so that if telephone or telegraph lines, which have normally low resistance to ground, parallel the transmission circuit, the current will flow along these wires, often with disastrous results to the circuits.

Two cases of trouble are particularly liable to give these conditions:

1. Where the neutral points of the high-tension windings of raising and lowering transformers are grounded, the opening of one or two of the three transmission wires will cause currents to flow through the ground.

2. A high-resistance ground on a transmission wire will partially short-circuit a transformer and cause current to flow through the ground to the neutral.



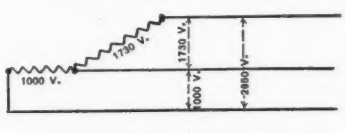


FIG. 5.—STAR-TO-DELTA, LOWERING. ONE SIDE OF DELTA CUT OUT.

While grounding of neutrals may be permissible in certain localities it may not be allowable in others; and in laying out a plant it would seem to be advisable so to arrange the apparatus that it may be safely operated without grounding the neutrals.

The delta system is the one giving the minimum chance of trouble. Under certain conditions, however, the star and star-delta systems will give satisfactory service.

Forthcoming High-Speed Travel Experiments in Germany.

The promised high-speed competition tests between steam and electrically hauled trains between Hamburg, Hanover and Berlin, will be made in the course of the next few weeks. These tests are to be a continuation of the high-speed electric train trials on the Berlin-Zossen military line. Speeds of 100 miles per hour at light load, and ninety miles per hour at heavy load, will be attempted. Both electric locomotives and motor cars will be tried.

The German Reichstag has made an appropriation for heavier rails and ties for the Berlin-Zossen line, and tests will be commenced upon this when the new material has been put down. In the tests made on this line about a year ago it was found that the high speed obtainable was limited by the light track construction, so that the full capabilities of the electric trains could not be determined.

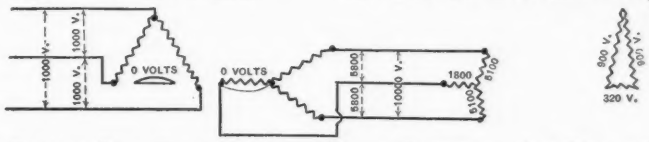


FIG. 4.—DELTA-TO-STAR, RAISING. STAR-TO-DELTA, LOWERING. ONE SIDE OF RAISING DELTA CUT OUT.

Meeting of the Faraday Society.

The first ordinary meeting of the Faraday Society, a British organization devoted to the interests of electrochemistry and electrometallurgy, was held June 30, 1903, at the rooms of the Chemical Society, London. The membership of the society is 238, but as few of the members live in London, there were only fifty present. The president, Dr. J. W. Swan, was unable to be present, and the chair was occupied by Mr. James Swinburne, one of the vice-presidents. An address from Dr. Swan was read, explaining the purposes of the society, and expressing the view that there was more than enough of useful and necessary work to be done on grounds now unoccupied by other organizations. The next business was the passing of rules which had been drawn up by the council.

Mr. W. C. Dampier Whetham gave a short account of his paper on "The Present Position of the Theory of Electrolysis." This sketched the development of the dissociation theory and showed how it explained electrolytic conduction of aqueous solutions. The author, however, did not think that sufficient data were at hand to warrant the extension of this theory to non-aqueous media.

Communications were read from Dr. Swan and Professor H. E. Armstrong, severely criticising the dissociation theory. The discussion was continued by Dr. Lehfeldt and Dr. Lowry, and a brief reply was made by Mr. Whetham.

Mr. James Swinburne then read his paper on "Chlorine Smelting with Electrolysis." Contributions from Dr. Swan and Mr. J. C. Richardson, discussing this paper, were read, and the paper was discussed by Mr. B. Blount, Dr. Steinhart, Professor William Thomson, Mr. R. H. Hutton, Dr. Mullineux Walmsley and Mr. Whetham. A brief reply was made by Mr. Swinburne. Papers by Dr. Lehfeldt, on "The Total and Free Energy of the Lead Accumulator," and by Dr. Perkin, on "Electrolytic Apparatus," were read by title. These will be discussed at the next meeting of the society. An exhibition was given of Dr. Perkin's apparatus.

The society then adjourned, to meet early in the autumn. After the adjournment refreshments were served in the library of the Chemical Society.

Mediterranean System of Electric Traction in the Neighborhood of Nice and Hydraulic Plant of Mescla.

By C. L. Durand.

ONE of the most extensive systems of electric traction in Europe is that which has been recently installed along the Mediterranean coast in the vicinity of Nice. It includes a number of lines within the city of Nice itself which use both underground conduit and trolley, as well as a line which runs for over thirty miles along the coast from Cagnes to Menton, taking in a portion of the Riviera, which besides being well populated is so largely frequented by visitors during the winter. The power for the system of traction lines is obtained from a hydraulic plant in the vicinity and is transmitted over a high-tension line to three substations. The whole installation has been carried out by the Compagnie Française Thomson-Houston.

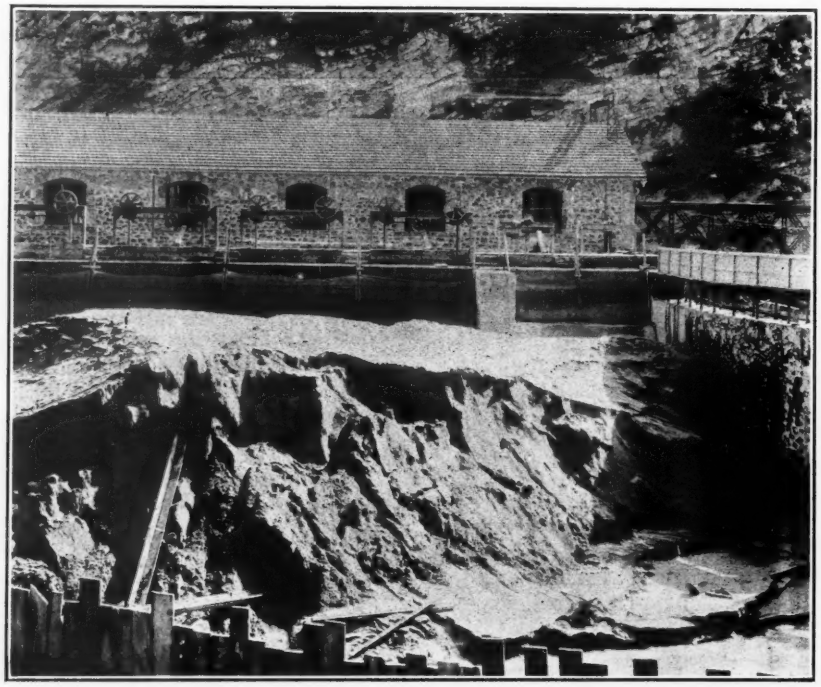


FIG. 1.—HYDRAULIC POWER STATION AT MESCLA, SUPPLYING POWER FOR THE NICE ELECTRIC RAILWAY SYSTEM.

The main hydraulic plant is located in the mountainous region in the neighborhood of Nice, and uses the power of the Var River to generate three-phase current at 10,000 volts for the main transmission line which runs to the principal substation at Nice and from there to two other substations located on the coast, at Californie and Beaulieu. These three substations are designed to transform the high-tension three-phase current produced at Mescla into direct current at 500 to 550 volts for the different traction circuits. The principal substation of Sainte Agathe, which is located at Nice, has also a steam generating plant which assures the working of the system in case of accident to the transmission line from Mescla. It contains the steam engines and dynamos which can supply the same current as received from the hydraulic plant. The high-tension line from Mescla to Nice, at 10,000 volts, is overhead throughout, while the lines from Nice to the two substations of Beaulieu and Californie are formed of underground cables.

At the point known as "La Mescla" in the valley of the Var, the river after receiving the Tinée makes a circuit around the mountain, and by connecting the two extremities of the loop a difference of level of thirty-five to forty feet is obtained, and as the output of the stream is about ten cubic metres per second, this gives the plant an available force of 2,000 horsepower. To carry this out a tunnel was pierced through the mountain which enabled the whole or a part of the waters of the Var to be brought to the turbines, which are located near the mouth of the tunnel. The photograph, Fig. 1, shows a view of the hydraulic station which is erected at this point. In the foreground is the settling basin with the water drawn off in order to clear out the large amount of sand which the stream draws down with it. The water upon leaving the turbines is not sent at once into the river below, but as there is still a considerable difference of level it is taken off by a tail-race which later on will supply a second hydraulic plant located a few miles from the first. The main turbines, which are three in number, can each take 7,500 litres per second. They are of the centripetal type, formed by a pair of conical

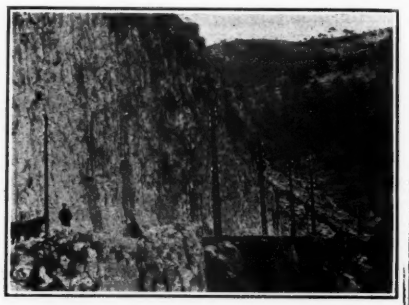


FIG. 2.—IRON POLES USED IN MOUNTAINOUS SECTIONS OF MESCLA-NICE TRANSMISSION LINE.

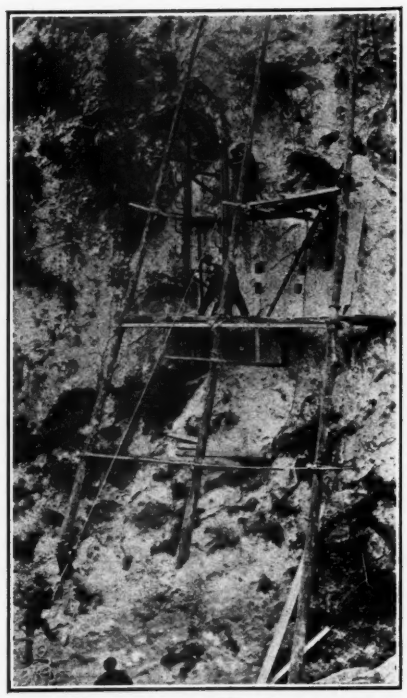


FIG. 3.—BRACKETS FOR HIGH-TENSION TRANSMISSION LINE, NICE ELECTRIC RAILWAY SYSTEM.

wheels, and receive the water from two distributors whose vanes are articulated and are operated by the mechanism which regulates the speed. The turbines are each lodged in a separate water-chamber built in masonry and the chambers can be closed by a movable gate in front of the entry. Each of the main turbines is

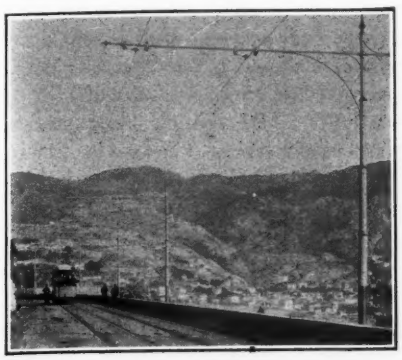


FIG. 4.—CONSTRUCTION ON COAST LINE SECTION OF NICE ELECTRIC RAILWAYS.

supplied with an oil-pressure governor of the Escher-Wyss pattern, which controls a small electric motor for regulating the turbine vanes. A pump worked by a special ten-horse-power turbine with horizontal shaft supplies the oil under pressure for operating the governors.

with a frequency of twenty-five cycles and furnish a tension of 10,000 volts which is sent directly into the line without using transformers. The exciting current for the alternators is supplied by two four-pole dynamos which are operated separately by two sixty-horse-power turbines. The high-tension switchboard is made up of standard apparatus and has three panels for the alternators, one station panel and two panels for the overhead lines, besides an exciter panel. All the parts carrying the high voltage are placed in the rear of the panels.

The construction of the overhead line across the mountainous region, which lies between Mescla and Nice, has been one of the most difficult parts of the work. The different engravings show the general character of the country traversed by the line. The high-tension circuit is formed of six copper wires of 7.25 millimetres diameter which form two separate three-phase lines. These two lines are designed to work in parallel under normal operation, but if an accident should disable one of them the other has a sufficient capacity to operate the plant. For this reason each line has a separate switchboard panel both at the start and finish. The line which is established in a

five to six feet deep, according to the nature of the ground, and are spaced 115 to 125 feet apart. Where the line passes over the roads or in inhabited places it is protected by a network of wires which is designed to catch the broken line and also connect it to ground. Six galvanized iron wires are stretched above and below the line and are cross-connected every fifteen feet by a transverse wire, the

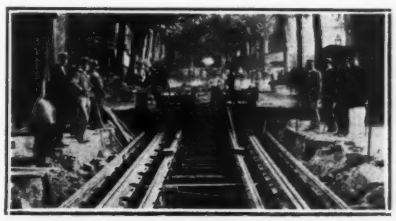


FIG 5.—CONDUIT CONSTRUCTION FOR NICE ELECTRIC RAILWAYS.

whole system being connected to ground, forming a sort of cage inside of which passes the line wire. In this way a very efficient protection is secured. Besides the lightning arresters at each end of the line, the poles are provided with lightning-rods. Special measures had to be taken to avoid disturbances to the telephone and telegraph lines which often run parallel to the high-tension circuit.

FIG. 6.—SUBSTATION AT SAINTE AGATHE, SHOWING GROUP CONSISTING OF THREE-PHASE 530-KILOWATT ALTERNATOR AND 500-KILOWATT RAILWAY GENERATOR MOUNTED ON ONE SHAFT AND THE HIGH AND LOW-TENSION SWITCHBOARDS, NICE ELECTRIC RAILWAY SYSTEM.

Each of the main turbines is directly connected by an elastic coupling to a twenty-pole three-phase alternator with an external fixed armature ring and revolving field mounted on a flywheel. These alternators are built for 500 kilowatts

rocky district over nearly the whole length is supported on porcelain insulators upon specially built trellis-work poles of considerable height, measuring from thirty-five to forty-two feet. The poles are planted in a bed of cement beton from

In some cases, where the lines run near together, a protecting network is placed between them, connected to ground, which also acts to some extent as a magnetic screen for cutting off the induction effects. The rocky nature of the country occasioned

considerable trouble in running the line. In the Gorges of Balmes, for instance, most of the construction material had to be brought to the spot on the backs of mules, over the narrow mountain roads, and not only were the iron pieces for the poles, which were assembled on the spot, brought in this way, but all the other material and even the water for mixing the beton. The line where it passes through the Gorges of Clues along the mountain road will be observed in Fig. 2; in some places the line is mounted along the side of the rock upon iron brackets, as noticed in Fig. 3. The line passes through the mountain region for nearly all its length, coming out not far from Nice, where it follows the Paillon River, and finally reaches the substation of Sainte Agathe, within the city.

The system of lines which is now in operation and controlled by the Compagnie des Tramways de Nice et du Littoral has a total development of nearly 100 miles of single track. It includes two distinct parts, the urban system of Nice and the coast line which runs along the whole of the coast from Cagnes on the west of Nice to Menton on the east, passing by Villefranche and Monte Carlo, and thus running through many of the stations of the Riviera which are so largely frequented during the winter season.

The city of Nice had two lines which used animal traction, and these were transformed and six new lines added, making a very extensive system. Two forms of traction are used within the city. In the central portions the underground conduit has been installed, while the remainder uses the trolley. The underground conduit system has been carried out on the same lines as the system which is now in use at Paris on the Bastille—Montparnasse and other lines. The central slot has been adopted, with a contact plow of the standard pattern. The engravings show the construction of the conduit and the overhead system. The trolley wires are supported either upon poles formed of steel tube or in most cases by rosettes fixed to the houses, as the use of poles has been avoided as much as possible.

The greater part of the Nice lines has been laid in double track with one metre gauge, while the coast line runs partly in double track and at other places in single track with switches.

All these lines are supplied with power either from the Mescla hydraulic station or by a steam plant which has been installed in the same building as the main substation of Sainte Agathe. The system is designed to be operated from the hydraulic plant under ordinary conditions, while the steam plant acts as a reserve. A view of the latter portion is shown in the engraving Fig. 5. It is equipped with engines, boilers and accessory apparatus to use normally 45,000 pounds of steam per hour. The engines, of which there are two of 700 horse-power each, are of the horizontal type with two twenty-inch cylinders provided with Corliss valves, with a twenty-six-inch piston stroke and running at 100 revolutions per minute. The steam is furnished by two batteries of four semi-tubular boilers each, having 185 square metres heating surface. Each of the steam engines drives by belt a group consisting of a triphase alternator and a direct-current generator. Both of these machines are mounted side by side upon the same shaft, as will be noticed. The alternator is a ten-pole machine of 530 kilowatts, giving 900 volts and running at 300 revolutions per minute, with a frequency of twenty-five cycles. The six-pole direct-current machine has a capacity of 500 kilowatts and is compounded so as to give a tension of 500 volts at no load and 550 volts at full load. Each of the alternators is excited by a small twenty-five-kilowatt machine driven by belt from the main shaft at 1,100 revolutions per minute and giving sixty volts. The alternating current at 9,000 volts is lowered by a set of step-down transformers to 340 volts, then changed to direct current at 500 to 550 volts by a group of rotary converters. For the feeder which supplies the Contes traction line a booster is used which is formed of a four-pole fifty-horse-power induction motor coupled direct to a thirty-five-horse-power generator running at 750 revolutions per minute and delivering continuous current at seventy-five volts. The station contains also six oil transformers of fifty-five kilowatts each which lower the tension of 9,000 volts to 5,000 volts for supplying the two substations of Californie and Beaulieu. Three smaller oil transformers of twenty kilowatts lower the tension from 9,000 to 110 volts for the motor of the booster set. The rotary converters use six transformers of the same type. The switchboard, which will be noticed to the right of the engraving, is provided with twenty-five panels in all for the high and low-tension circuits, and is made up of standard apparatus. The station is lighted by a twenty-kilowatt group consisting of a twenty-kilowatt 500-volt motor which drives a 120-volt generator at 875 revolutions.

The two substations of Beaulieu and Californie are similar in construction. They are fed by three-phase current generated at the Sainte Agathe plant and are connected to it by an underground circuit formed of lead-covered cables with iron sheathing. The cables contain three conductors of thirty square millimetres section each. The distance to the Californie substation is 4.8 miles and to the Beaulieu six miles. Each of these substations contains two rotary converters of the four-pole type, giving 150 kilowatts at 750 revolutions per minute. These machines deliver current for the traction lines at 500 volts no load and 550 volts full load. The plant includes six stationary transformers of fifty-five kilowatts which lower the tension from 4,300 to 340 volts for supplying the rotary converters, besides a switchboard of six panels for the alternating and the direct-current side.

The system of feeders for the line has a total development of twenty-three miles. It is generally laid underground; of the two overhead portions one is used for the Contes line and the second for the section which is fed by the Beaulieu substation, and these two have a total development of six miles. The overhead feeders are formed of cables of 125 square millimetres section and are mounted upon insulators on the same poles as the trolley wire. The system of underground feeders starting from the Sainte Agathe station is formed of armored cable of 200 or 400 square millimetres section, and runs for the most part through the city of Nice. An extensive system of pilot wires has been specially designed to connect the station with the main points of the system and thus observe the drop of voltage in the return circuits in order to avoid danger from electrolysis.

The motor cars, of which there are over a hundred, are each equipped with two G. E.-58 motors and the usual standard apparatus, besides carrying a special apparatus with contact plow in order to pass from the trolley to the underground conduit parts of the road, and inversely.

A New Automobile Record.

The world's record of flying kilometre was lowered in the motor speed trials which took place at Phœnix Park, Dublin, on July 4. This feat was accomplished by Baron De Forest on a seventy-horse-power Paris-Madrid Mors machine, who brought the record—which previously stood at twenty-nine seconds—down to 26.6 seconds. This represents traveling at the rate of eighty-six miles an hour. In other tests, held the same day, previous records were also reduced, including those for motor cycles and tourist cars.

ELECTRICAL MINING NOTES.

BY SIDNEY F. WALKER.

At the recent meeting of the British Institution of Mining Engineers in London, a paper upon the breakdowns of electrical plants was read by the electrical engineer to a boiler insurance company which has taken up the insurance of dynamo machines. The author strongly condemned the present practice of working plant up to its full output. The question is a somewhat difficult one, where supply generating stations are concerned, as there is always a staff of skilled men at hand which can put things right at small cost and in a short time, and the difference in coal and accessories may be considerable between working at low load and working near full load. But the case where electrical apparatus is used in mining work is quite different. Stoppage means considerable loss, and efficiency is to be measured, not by the immediate return of work for power expended, but the cost of doing the work required, and in this the repairs bill may bulk very largely, if plant is worked up to its full capacity; while stoppages, if frequent, will discount any good effects produced by the improved apparatus. The author of the paper pointed out correctly, that an insulation test was of little service as a test of reliability, though a temperature test might be of service. As in all apparatus which is to do continuous work, there is only one test which is of any real value, and that is the work itself. A guarantee by a good firm, to make good any part of the apparatus that fails within a certain time, coupled with satisfactory enquiries as to the behavior of similar apparatus, is probably the very best safeguard that a user of electrical apparatus can have. He may have assistance from genuine experts, from men who have practical experience in the particular class of apparatus in question, and who will be able to judge at a glance whether the wire, for instance, on the armature is likely to stand the heat to which it will be subjected, whether the spindle is large enough or the brush-holders are satisfactory, etc. Further, there is no doubt that if some one connected with the user of the apparatus, an expert who really understands his work, could see the progress of the apparatus from time to time, it would probably save many breakdowns. There are of course difficulties in the way of carrying out a suggestion of this kind. Manufacturers do not want experts about their works who are going into other works, and may take with them little wrinkles which they wish to keep to themselves. Again, colliery owners and colliery managers are very much in the position of spoilt children. They have had the commercial workers who wish to do business with them at their feet for a very long time, and it is almost against their religion to pay a consulting fee. The plan adopted is too often, for the engineer at the colliery, who rarely knows much about electricity, to pump the would-be contractors until he thinks that he has got hold of the subject sufficiently, and he then makes a report advising that so and so's tender be accepted, he having previously secured himself with this firm.

The author of the paper on plant failures also strongly recommended periodical inspection of plants. The table given by the writer, with the paper, is very instructive, but is strictly in accordance with the present writer's experience and, he believes, that of others. Of the total number of breakdowns which occurred, armatures were responsible for seventy-eight per cent, and of these commutators for thirty-three per cent. Mechanical portions are given at twenty-five per cent, brush gear at seven per cent, field magnet coils at ten per cent. It will be noticed that the percentages do not quite agree. There are more parts than make up the whole, but this is explained by the fact that some of the faults had to be classed under two heads. Of the mechanical failures, shafts come out very well. Bearings are responsible for a good proportion of failures, some 8.6 per cent, binders of armature coils for 9.4 per cent. Of the electrical faults, armature coils short-circuited account for twenty-nine per cent, and armature coils earthed for 19.5 per cent, breakage of wires of armature coils to 15.6 per cent. The author also appends a table showing to what causes failures may be attributed generally, and he assigns eighteen per cent to bad design, 13.6 per cent to bad workmanship, 1.56 per cent to overrating, a very small percentage considering the usual practice, 7.4 per cent to dust and damp, and 2.5 per cent to want of attention; thirteen per cent is classed as unknown, and 5.5 per cent as due to faults in accessories. In the discussion which followed, it was complained by some contractors and manufacturers present, that the number of failures had not been stated. In his reply, the author of the papers gave seven and one-half per cent as the percentage of failures which had occurred, taken over four years. This was the percentage per annum of the total machines insured with the National Boiler Insurance Company, whom the author represented. He also gave as the average life of electrical plant, four years. This included all kinds of machines, new and old, and all classes of work, largely mining.

Coal-cutting came up for discussion in this paper, and a member suggested that a committee of the institute should investigate coal-cutting. One contractor who spoke stated that of sixty-five machines which he had working at different collieries, the average life was eight and one-half years, and the percentage of failures only two per cent, and this included a case where a motor had been drowned for two months by an inrush of water at a colliery, and was burnt on starting. Another maker complained very strongly that electrical apparatus was often put into the hands of incompetent men to look after, and thought that the motor of a coal-cutting machine was often blamed when it was the machine itself which was at fault.

Another manufacturer thought that electrical apparatus was subjected to fewer breakdowns than any other apparatus, and when specifying for apparatus, the time during which the apparatus would be running continuously should be stated.

The paper on electric driving of winding gears, or hoists as they are called in America, was very interesting. It was read by one of the staff of Messrs. Siemens Brothers. Messrs. Siemens have not done a great deal of mining work in the United Kingdom, but the firm of Siemens & Halske, of Berlin, with which they are connected, has done a good deal in Germany. Some twenty years ago they fitted up an electric locomotive in a coal mine in Westphalia, the Zankeroda, where the current was taken from an angle iron placed at a convenient height, with a little carriage running on it connected to the locomotive. Mr. Hird, the writer of the paper, detailed the work which had been done in this country and on the Continent previously to his firm taking the matter in hand, which was practically the adoption to one or two electric motors to winding, by attachment to the winding engine, through gearing, with the usual starting resistance; and the paper then went on to explain that this arrangement was very wasteful. Winding or hoisting is very different from any other work which an engine or a motor is likely to be called upon to perform. At a colliery, for winding, there are two wire ropes coiled up on a drum, one attached to each cage.

Each rope is made long enough to allow its cage to descend to the bottom of the shaft, and each cage descends and ascends alternately, so that its rope is alternately being run out from the winding drum and being coiled up on it. Winding, or hoisting, is accomplished simply by revolving the winding drum, and coiling the rope up which happens to be run out, the other rope unwinding in the process. It will be noticed that when the cage, usually loaded either with coal or men, is first started off its supports at the pit bottom, a very heavy strain is brought upon the engine or motor which is revolving the winding drum, but as the cage ascends the rope attached to it becomes shorter and shorter, while that attached to the descending cage becomes longer and longer, and at a certain point in the shaft the work to be done upon the ascending cage is balanced by the work being done by the descending cage, and from that time forward till the end of the wind, till the ascending cage is landed upon its props, the energy delivered to the winding drum by the descending cage is greater than that demanded by the ascending cage. Evidently this is a case where electricity should come in at its best, but not with the old plan of simply adding a resistance to the motor, to be used for starting. It is at starting that the consumption of energy is usually greatest and to add to this consumption by wasting energy in heating resistances means to lower the efficiency very considerably. Added to this, the arrangement does not provide for taking advantage of the excess of energy delivered by the descending cage during the latter portion of the wind. After a good deal of experimenting, the plan almost universally adopted has resolved itself into the provision of a special generator for the winding current, the excitation of which is controlled in place of controlling the current passing through the armature, the control being effected by the engine driver himself by a succession of contacts upon his lever. Various methods of controlling the excitation of the generator for the winding current were explained by the author, but the final form, up to the present, according to the experience of Messrs. Siemens & Halske, is that known as the Siemens-Ilgner system. Mr. Ilgner is the engineer of some mines in Germany, and he has worked the system out in conjunction with Messrs. Siemens. The system is a very pretty one. A separate generator is provided for the winding current. It is usually not driven by a steam engine, but by the electrical supply service. It is a motor-generator, and the supply service may be whatever is convenient. Usually it is three-phase in the installations which have been put down. To the axle of the motor-generator is attached a heavy flywheel, whose office is to absorb the surplus energy which is given out by the descending cage. The field current of the generator of the motor-generator is supplied by a small generator driven by the motor which is in connection with the supply service. The current from the motor-generator is taken directly to the armature of the motor which drives the winding drum, and the field circuit of the motor which drives the winding drum is also supplied by the small auxiliary generator which supplies the field of the motor-generator. The resistances necessary for controlling the two field circuits are brought to contacts which are worked over by the engineman's winding lever. When the winding first commences, and a large supply of energy is demanded, it is furnished by the motor-generator; the motor taking what it requires from the supply service and handing it on to the winding plant. When the descending cage is giving up more energy than is required to lift the ascending cage, and in fact from the moment when the strain upon the winding motor is relieved, the flywheel of the motor-generator takes up the surplus energy and stores it, to assist the supply current at the next wind. It is stated that with this method only forty pounds of steam per brake-horse-power actually exerted is consumed, while with the best forms of steam-driven winding plants ninety pounds is the rule; and with the majority of winding plants it is very much more. The author of the paper also describes an arrangement for electric winding which was exhibited at the Dusseldorf Exhibition, in which a somewhat similar arrangement ruled, but the surplus energy of the descending cage was taken up by a storage battery accumulator. This is stated not to be so good for the purpose as the flywheel, and with this the present writer agrees. Electrical accumulators are hardly the things to use about a coal-pit at present. At the same time the rivalry between the two aptly illustrates that between the two systems of storage. The mechanical method of storage by means of a heavy flywheel has much to recommend it, but it has also drawbacks, and it is doubtful if it will hold its own in face of a really good and reliable storage battery, when colliery people have acquired more knowledge of electricity.

The other paper presented to the Institution described a small hydraulic electrical plant which the author of the paper had fitted up in North Wales in connection with some of the slate quarries at Bala Festiniog. The object of the author, he stated, was not so much to describe his plant, as to call attention to the restrictions which the British Board of Trade exercised over developments of the kind. The English Board of Trade is a government department to which is entrusted the regulation of all sorts of matters, but in particular the supply of electricity for lighting and power. The result of the reading of the paper was that a committee of the institute was appointed to approach the Board of Trade on the matter. The present writer and others have been constantly urging upon colliery owners the advantages, where there are several collieries under one management, of putting down a central station to generate electrical energy to supply light and power to all the machines at all the collieries, but if they are to be regulated at every step, the gain will be very doubtful.

Journal of the British Institution of Electrical Engineers.

The June issue of the *Journal* of the British Institution of Electrical Engineers contains the following papers, with discussions: "A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms," by M. B. Field; "Distribution Losses in Electric Systems," by A. D. Constable; "Divided Multiple Switchboards; an Efficient Telephone System for the World's Capitals," by W. Aitken; "Methods of Supporting and Protecting Inside Conductors," by O. L. Falconar; "Some Notes on Continental Power-House Equipment," by H. L. Riseley; "Network Tests and Station Earthing," by A. M. Taylor; and "The Arrangement and Control of Long-Distance Transmission Lines," by E. W. Cowan. There is also given an abstract of a discussion on "Electric Wiring Up to Date," which was held at the meeting of the Glasgow local section.

Accumulator Cars in Wales.

Another trial of electric accumulator cars is being made on the Swansea & Mumbles Railway, South Wales. Two vehicles are being employed, each accommodating about eighty passengers. The cars were built by the Brush Electrical Engineering Company.

The Edison Interests at West Orange, N. J.

A Description of the Extensive Works Manufacturing Some of the Inventions of Thomas A. Edison.

THE manufacturing plant for the production of a number of the inventions of Mr. Thomas A. Edison, at West Orange, N. J., contains many features of more than ordinary interest to the trained mechanic and engineer, and of instruction and profit to the visitor not so familiar with mechanical apparatus. The works are pleasantly situated in a country locality which, while being far removed from the city environment, is easily accessible by both steam and electric trolley service. Passing through the office of the gatekeeper, which commands the front entrance to the works on the Valley Road, the first point of interest is the private laboratory, reception room and experimental department of Mr. Edison. The experimental plant is located in a large brick structure, three stories high, and the mechanical outfit has the appearance more of a heavy machine shop than of an experimental mechanical laboratory.

LIBRARY AND RECEPTION ROOM, LABORATORY OF THOMAS A. EDISON, WEST ORANGE, N. J.

The reception room is situated in the extreme front of the experimental building, and this is invitingly fitted up with easy-chairs and accommodations for the visitor. It is here where Mr. Edison receives most of his visitors, as this is where his desk is situated and the room is of convenient access to the experimental stockroom and machine rooms beyond. This reception room has two galleries which follow three sides of the room, the northern wall being of a more or less ornamental nature, as may be seen from the accompanying illustration. On the ground level of the reception room is a number of models of various kinds, and an extensive technical library which is for the use of the laboratory staff of experimenters. In the first gallery is located one of the most remarkable and complete mineral collections which is on exhibition to-day. This is the collection which Mr. Edison secured from the Tiffany Company, and had largely been gathered by Mr. George F. Kunz, who has attained a great deal of prominence in the field of mineralogy. The second gallery is used for storing various materials and for the filing of records.

Immediately to the east of the reception room in the experimental building is the stockroom, wherein are stored all chemicals and the finer apparatus necessary for the work of the experimental staff. Beyond this are the machine rooms for the building of experimental tools and the heavy pieces of apparatus necessary for the manufacturing of special products. This machine room is thoroughly equipped with milling machines, planers, radial drills, lathes, boring machines, slotters, punch-presses and various other machines of this nature. On the floor above are lighter machines for special experimental purposes. On this floor, and also on the floor above, are testing rooms and different departments for work along special lines.

Continuing to the east in this building, along Lakeside avenue, is the boiler room, and beyond this the dynamo room for supplying the light to the experimental building and electric current for the motor drive in several of the other factories.

Beyond this building, and extending to the tracks of the Erie Railroad, are the executive offices of the works. Here are located the managers of the different departments and a large force of clerks attending to the clerical details of the various organizations.

The whole plant occupies quite a large plot of ground, the buildings being placed very much after the order of a hollow rectangle.

Adjoining the Erie Railroad tracks, a spur of which runs into the ground of the Edison works, is the main machine room. Here are manufactured nearly all of the parts of the various machines turned out for the different selling companies which represent the Edison interests. In this machine room are made the stampings and turnings for the Bates and Edison numbering machines, fittings and appurtenances for the Edison phonograph, the Edison kinetoscope apparatus, and some of the material which goes into the assembly of the Edison primary battery and the Edison primary battery fan motor.

At this point it might be well to state that while the Edison primary battery is assembled at the works at West Orange, the manufacturing of the parts is mostly all done at Silver Lake, N. J. There is still some experimenting being done on Mr. Edison's storage battery at the West Orange works, but the machinery, outside of the experimental machinery, is being put up and placed in operation at Glen Ridge, N. J. Some of the experimental machines for the Edison Portland cement works are still made at the experimental department at West Orange, but the heavy machinery and manufacturing apparatus are practically all in place at Stewartsville, N. J.

The accompanying illustrations show views of the main machine room; one illustration showing a double row of automatic screw machines. The operation of

the machines is remarkable in many ways, as long, straight pieces of metal are fed into the machines, coming out either finished as screws or as shafting of greater or less dimensions, with one or more flanges cut in in one operation. In this room there are also the punch-presses for stamping a number of the fittings for the different classes of apparatus, the engraving department for cutting the figures in the steel dies for the numbering machines, the gear-cutting machines for cutting the different gears and segments which operate the phonograph machines and the projecting kinetoscopes; and one end of the building is given up to the sapphire department exclusively. Here are prepared the sapphires which are used in the registering and reproducing apparatus connected with the phonograph, and also in preparing the tools for shaving the record blanks.

A special line of screw-cutting machines is installed in this building, the working of which has to be very carefully and accurately manipulated. These are particularly for cutting the threads on the main shaft of the phonograph machines, these threads being cut to a pitch which has a ratio of one hundred to the inch. On this thread is fitted a mandrel nut which engages with the screw cut inside of the record, this causing the record to travel from right to left during the operation of the phonograph machine. In the main machine room is the raw material stockroom and the machine tool stockroom.

Adjoining the main machine room there is a smaller machine department which is used principally for making the parts for the Edison battery fan motor and assembling this apparatus. In this room is also the tool-making department, which makes up the tools for the various operations throughout the factories.

The next building on the trip around the rectangle is the shipping department and the assembly room for the phonograph apparatus. Here the different materials which go to make up the phonograph apparatus are brought together, and the phonographs assembled.

On the second floor of this building is the testing department, where the phonograph machines are tested for mechanical efficiency and perfection.

Beyond this, the next building is the planing mill and box-making and cabinet-making department. Here packing boxes for shipping the finished product, and also the cabinets for the phonographs and for the kinetoscopes are made up from the raw material to a finished state, the varnishing and lettering being completed in this department. A number of ingenious machines in the way of planers, wood-cutters and nail-drivers are to be seen in this department; and it is here, with the exception of the record-moulding department, that there is the evidence of the greatest utility of the labor-saving machinery installed.

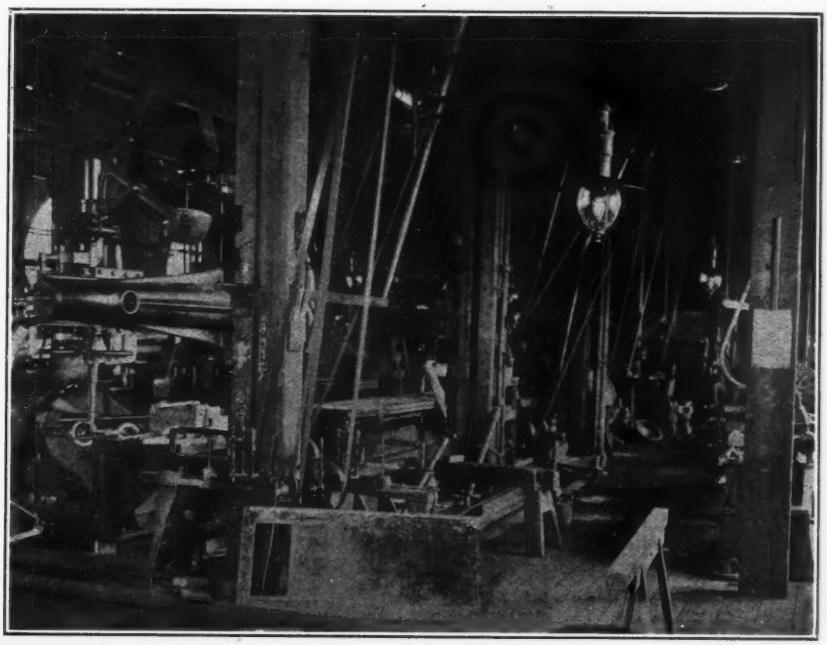
The building in which the records are made is one of the most interesting departments of the Edison plant. Here the master records are produced for reproduction which runs into the thousands and sometimes into higher figures than this. The making of a master record is attended with more difficulty than is ordinarily understood. There has to be exercised a great deal of ingenuity in so bringing out the characteristics of any selection spoken, sung, or played to the master instrument that in reproduction the delicate registrations may not be so flattened out that they will be either harsh or indistinct in rendition. While the theory of the operation of the phonograph may be very well understood, it may not be out of place here to sketch briefly the essential points in the phonographic reproduction of sound. When a human voice tone is articulated or a musical note is struck, the air immediately surrounding the seat of such a disturbance is set into vibration more or less rapid, according to the character of the disturbance caused by such a sound. If we take the note produced by rubbing a string which is of such a length that it vibrates 256 times per second, we get what is commonly known as the concert C pitch. If the string is composed of such material that its vibrations are of greater amplitude than those of some other material, the volume of the sound will be greater. With a greater amplitude of vibration there is consequently a greater condensation and rarefaction of the air surrounding the sound-producing apparatus. These condensations and rarefactions radiate in a spherical manner from the point of disturbance, and striking on a diaphragm or membrane stretched across any opening will cause it to vibrate at the same frequency as the initial period.

The master phonograph instrument is fitted with a wide-mouthed horn which terminates in a narrow neck closed by a membrane or diaphragm, to which is attached a sapphire stylus. Rotating at a rate which causes it to travel one inch laterally while rotating 100 times, a specially prepared record is cut by the stylus as the vibrations of different frequency and amplitude impinge on the diaphragm. Sometimes it is necessary for the master record to be made over and over again until a perfect result is secured. These master records are thoroughly tested by musical and mechanical inspectors. The former test is made by running them through a phonograph, and such as satisfy all requirements under this inspection are tested again. An examination is then made with a microscope to determine if the surface of the cylinder is satisfactory in all particulars. When

AUTOMATIC SCREW MACHINES IN THE MAIN MACHINE SHOP, AT THE WORKS OF THOMAS A. EDISON, WEST ORANGE, N. J.

a good record has been secured this is used for forming the mould.

The first step in forming the mould is to electroplate the master record. Into one end of the record is thrust a metal plate, to which is attached an iron armature. This head rests on a conical pivot and thus supports the record. Close to and parallel with the sides of the record are suspended two strips of gold leaf attached to two electrodes. Over the whole is placed a glass bell jar, and by means of a pipe connected to the base of the stand the jar is exhausted. Just without the glass jar, and at the same height as the iron armature mentioned above, is a magnet which revolves around the jar and thus sets the record in rotation. An arc is passed between the gold plates, which vaporizes the gold and deposits it upon the record as it spins. In this way a thin, uniform coating of gold is obtained over the outer surface of the master record. The record is then removed and placed in a copper-plating solution, and a deposit of copper of one-sixteenth of an inch made, this process requiring several days. When a sufficient thickness has been secured the mould is taken out and the copper turned off to a true cylindrical surface with the master still in it. This is then fitted into a brass shell, which forms the body of the mould, and the record is complete and ready for moulding after the master has been removed.



THE MECHANICAL PLANT OF THE EXPERIMENTAL LABORATORY OF THOMAS A. EDISON, WEST ORANGE, N. J.

A VIEW IN THE MAIN MACHINE ROOM AT THE WORKS OF THOMAS A. EDISON, WEST ORANGE, N. J.

After the gold-plated shell has been properly seated inside of the hollow brass mould the mould is placed in a proper receptacle, and it then becomes the work of the moulding crew to carry out the next process of manufacture. The moulding room is divided into a number of what are technically termed "kettles." To each kettle there is a crew, each member of which has his special work to do. The first step in the process of manufacture after the matrix has been perfected is to place the mould into a proper receptacle, which lowers it into a vat of molten composition, whereupon the molten material being at a much higher temperature than the metal mould, a thick film of composition congeals around the interior of the mould, the periphery of the film taking on the impressions of the gold-plated matrix. The mould is then taken out of the molten bath and placed on a forming machine, when it goes through several operations which turn upon the inside of the record a thread which fits the mandrel which carries the record from right to left in the phonograph machine. After this thread has been properly made the mould is plunged into a chilling solution which causes the record to contract sufficiently to drop out of the mould. The record is then taken to another machine which simultaneously trims and finishes the rough ends of the record. Following this process the records are next placed upon a slowly rotating mandrel, where they are judged for accuracy as to roundness, trueness to gauge and general perfection. The records are next taken to the department where they are sorted as to selection, and finally are carried upstairs, where they are wrapped and packed for delivery to the shipping department.

The phonographs in use are mostly all operated by a spring motor. While the machine, as completed, is apparently a simple piece of apparatus, still there are quite a number of parts going into the building up of a perfect machine, and several of these parts have as many as twenty-five operations performed before they are completed. After the records are properly made, they are placed upon a mandrel which is rotated by means of a spring and clockwork. A sapphire button or ball, of such diameter that it will engage the indentations which were made by the registering stylus on the master record, is fitted to a diaphragm or membrane which covers the neck of the phonograph horn. As the sapphire button or ball is thrown into vibration by engaging

with these indentations on the rotating record, the diaphragm is thrown into vibration of a similar frequency, which, in turn, causes the condensations and rarefactions in the air which affect the sensitive organ of hearing, completing the cycle of operation. As the record is rotated it is moved from left to right by the mandrel nut which fits over the thread on the main shaft.

There is everywhere apparent in each of the several departments which are utilized in the production of the Edison apparatus the evident great demand for each article. The Bates and Edison numbering machines are used in every city in the world, and the output annually has increased far beyond the most generous expectations. The Edison battery fan motor is a most popular piece of apparatus, and a large number of operators are kept continually busy supplying the demand. The kinetoscope still holds its own as an amusement feature in numberless resorts; but it is as regards the phonograph that one is particularly impressed with the extent to which the general public will patronize a legitimate amusement feature. Within the past few years the demand and output have increased fourfold, and the factory is now working twenty hours out of the twenty-four to supply the market for this scientific amusement device.

British Engineering Standards Committee.

The British Engineering Standards Committee has already begun work, the result of which it is hoped will simplify and cheapen the manufacture of electrical machinery in England. In addition to the Electrical Plant Committee there are several subcommittees now sitting. The government is supporting the work, and has appropriated $15,000 toward defraying expenses. It has also appointed members to represent the different government departments on the main Electrical Plant Committee and on the several subcommittees.

The main Electrical Plant Committee met in July, 1902, and divided the work into four heads—physical standards, mechanical standards, telegraphs and telephones, and power. The last heading has been subdivided into generation and transformation, transmission and distribution, and utilization; and the subhead of utilization has been further divided into light, traction, power, heat and electrochemics.

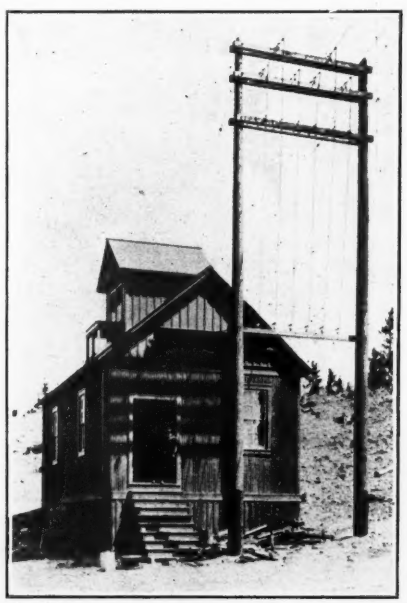
The following are the chairmen of the various committees: Electrical Plant Committee, Sir William Preece; subcommittee on motors, generators and transformers, Colonel R. E. Crompton; subcommittee on cables, R. Kaye Gray; subcommittee on telegraphs and telephones, John Gavey; subcommittee on electric tramways, A. P. Trotter; subcommittee on central station rules, C. H. Wordingham. A small committee has also been formed under the title of subcommittee on the temperatures of insulating materials, Dr. R. T. Glazebrook, chairman.

ELECTRICITY IN PLACER MINING.

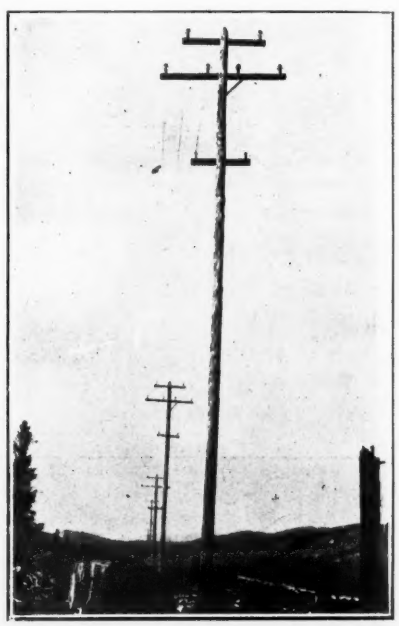
PLANT OF THE GOLDPAN ENGINEERING AND MINE SUPPLY COMPANY, BRECKENRIDGE, COL.

BY JAMES E. JOHNSTON.

The development of the vast mineral resources of Colorado has been very materially aided in many instances by the ultilization of the energy of her mountain streams, electricity being the main medium of application. The intermittent character of the flow of these streams, however, has been the most serious drawback to the extended use of water power in this section of the Rocky Mountains. Still for some purposes, this is not as great an obstacle as might at first seem. This is especially so in the case of placer mining,



SUBSTATION OF GOLDPAN ENGINEERING AND MINE SUPPLY COMPANY.



POLE LINE OF THE GOLDPAN ENGINEERING AND MINE SUPPLY COMPANY.

which can only be prosecuted during the summer months, at which time, even the most insignificant of these streams, becomes a veritable torrent.

The Goldpan Mining Company, of Breckenridge, Col., has the largest placer mining plant in the state, if not in the United States. This plant, outside of the direct application of water under pressure to the washing of the gravel and elevating same from the pit, is largely operated by electricity.

Spruce Creek, some five miles above the present scene of operations, is the source of power. This is diverted from its natural channel and conveyed to the pressure box by means of a ditch some two miles long. From the pressure box to the generating station the water is conveyed in a steel pipe of varying diameter and thickness to suit requirements. The total effective head is 425 feet and the working pressure about 206 pounds.

The generating plant consists of two 200-kilowatt, alternating-current Westinghouse generators, delivering two-phase current at 440 volts, and direct-connected to two Pelton water-wheels.

The arrangement of these generators and wheels is novel and deserves mention. The wheels are set as closely together as possible to allow their extended shafts to pass each other. The shafts are thus parallel and of the same length and some four feet apart. On each end of each shaft is mounted one-half of a flexible coupling of the leather link type. At each end of this arrangement is placed a generator which by a tension screw and guides can be placed so that its half coupling can engage with either shaft. Normally one generator will be used on each wheel, but the plan allows either wheel to be operated with either generator and provides for emergencies that otherwise could not be met.

Two exciters, each of capacity sufficient to excite both generators, are provided. They are direct-connected, each to a suitable Pelton wheel.

As a portion of the current generated is used in lighting the town of Breckenridge and the remainder is applied to motor work of an intermittent nature, the switchboard is provided with two sets of busbars which allow of either multiple or separate running. This board is of

blue Vermont marble provided with a full line of measuring instruments of the long scale type.

The raising transformers are located in a separate building and are of the Westinghouse oil-cooled type. The line pressure is 10,000 volts, three-phase, it being the intention ultimately to cover greater transmission distances than is now done.

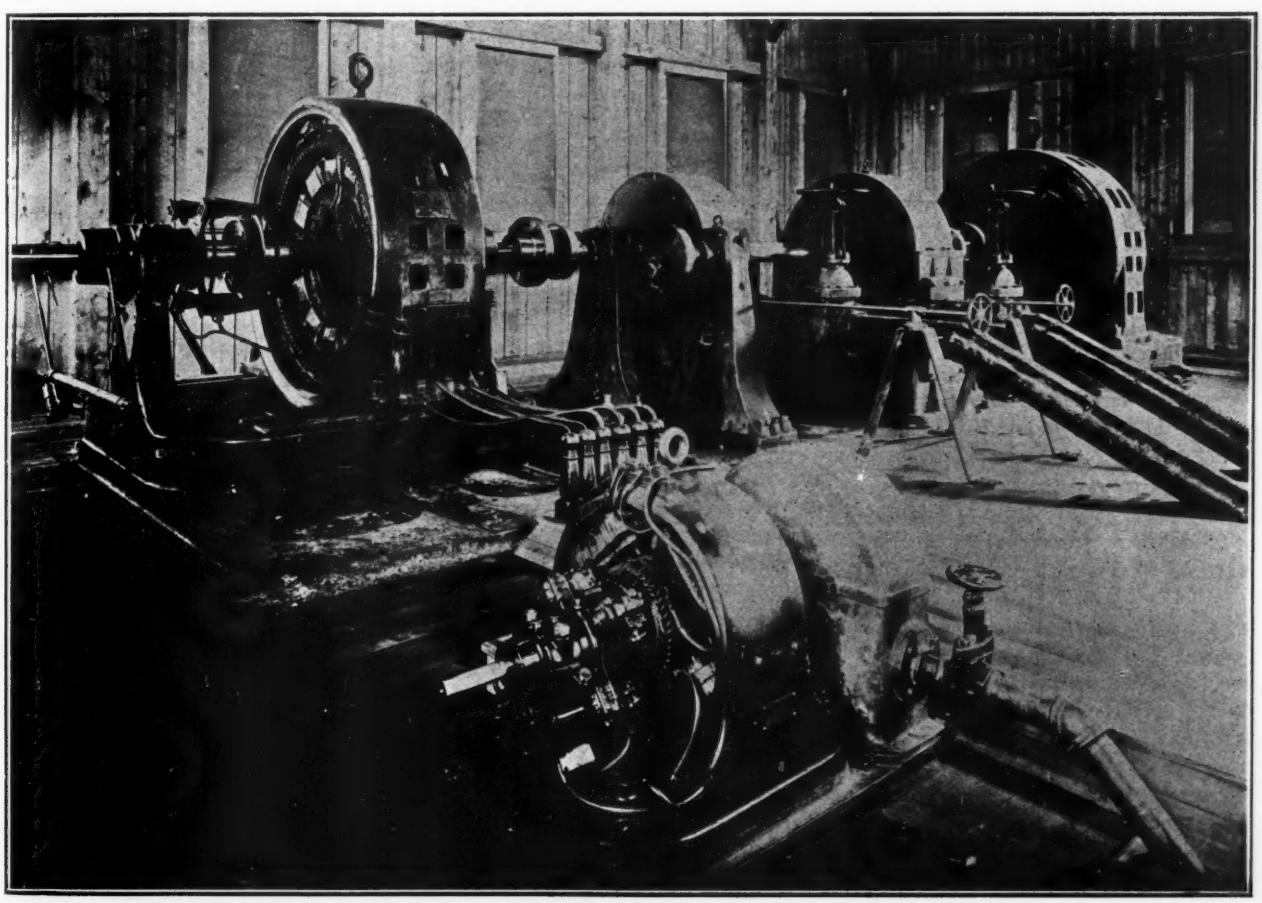
The line is of No. 5 copper, two circuits of three wires each of one set of poles. Glass insulators are used.

The principal use in mining to which the power is applied is the driving of pumps, lighting the pit, etc. Two electrically driven portable cranes are used in moving larger boulders, etc. These cranes are of the boom type, and are equipped with variable-speed alternating-current type F motors capable of exerting thirty horse-power. One 150-horse-power constant-speed motor is used to drive a centrifugal pump and assists in keeping the pit dry. There is also a well equipped machine shop driven by a fifty-horse-power constant-speed motor. In this shop were made the large wrought-steel water mains used in the placer system.

Distribution of current is made to these motors at 220 or 440 volts, according to location, from a substation at Breckenridge. The lighting of the town is from 2,200-volt mains, also from the same substation.

The plant has been in full operation for a short time only but has proven the wisdom of the outlay by materially reducing the cost of the mining operation.

GENERATOR STATION AND TRANSFORMER HOUSE OF THE GOLDPAN ENGINEERING AND MINE SUPPLY COMPANY, BRECKENRIDGE, COL.



INTERIOR VIEW OF THE GENERATOR STATION, SHOWING PLAN OF DRIVING FROM PELTON WHEELS, GOLDPAN ENGINEERING AND MINE SUPPLY COMPANY, BRECKENRIDGE, COL.

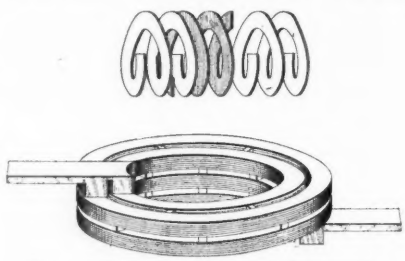
Transactions of the American Electrochemical Society.

The third volume of the transactions of the American Electrochemical Society is being distributed. This contains the proceedings of the spring meeting, held in New York city April 16 to 18. Although the society has been organized but a little over a year, it has a membership of 510.

Electrical Patents.

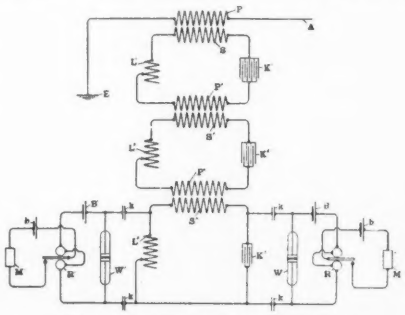
A coil for dynamo-electric machines has been invented by Mr. Hermann F. T. Erben, of Schenectady, N. Y., and the patent obtained thereon has been assigned to the General Electric Company, of New York. This invention relates to a method of making heavy field coils for dynamo-electric machines, such as the series coils for compound-wound motors and generators. The coil which is produced consists of a plurality of parallel layers of a flat copper conductor wound edgewise, the layers making one or more turns, as determined by the design of the machine, and connected in series or in parallel, as the case demands. If connected in parallel, the coil is, in effect, the same as a solid bar having the same cross-section as the combined layers; but it has been found that the mechanical difficulties involved in winding a solid bar of large cross-section practically prohibits such construction. In winding a coil composed of a plurality of parallel strips of small size the several strips might be wound simultaneously, each being run through its own tension device; but for large coils this is impracticable, owing to the difficulty of obtaining a winding machine sufficiently strong to bend all at once the full section of copper. This invention obviates this trouble, permitting the several layers to be wound successively. The invention consists in forming the requisite number of convolutions or layers of metal separately, assembling them side by side in parallel relation, and securing their adjacent ends to suitable terminals. The inventor prefers to use a flat-sided conductor, such as a flat strip, of considerably greater width than thickness and of even dimensions throughout. To form the separate convolutions, he winds such a strip edgewise into a helical coil of a large number of turns, then cuts the coil into lengths, and then interweaves the lengths by screwing them together until they all lie parallel with their ends flush. The ends of the layers are then soldered together and to a terminal of proper cross-section. If a greater cross-section of coil is desired, a second coil of smaller or greater diameter can be similarly constructed and slipped inside or outside of the other, the terminals of the two being connected in parallel.

The Consolidated Wireless Telegraph and Telephone Company, of Philadelphia, Pa., a corporation of Arizona Territory, controls a patent issued to Cornelius D. Ehret, of Ardmore, Pa., on improvements in wireless signaling systems. By this system the electroradiant energy is received upon a suitable receiving conductor or conductors and produces therein fluctuating electric currents of a frequency equal to that of the transmitted energy. The receiving conductor is itself so adjusted as to its electrical constants as to be selective of energy of a predetermined frequency, and associated with such receiving conductor or circuit are one or more circuits, each of which is also



Coil for Dynamo-Electric Machine.

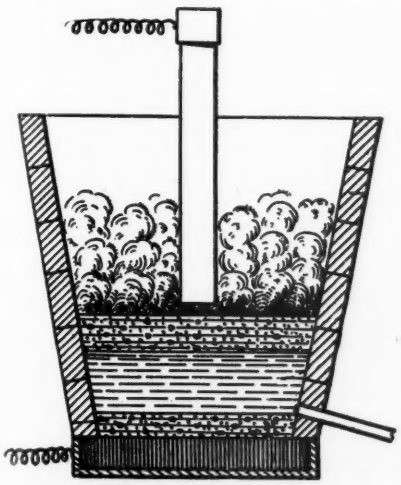
adjusted as to its electrical constants as to be selective of currents of a frequency equal to that of the transmitted energy. These circuits are preferably arranged inductively in tandem with each other, and the capacity and inductance of the first circuit will produce a product equal to the product of the capacity and inductance of each succeeding circuit; but it is the inventor's intention to have a relatively great capacity in the circuit nearest the receiving conductor or circuit while the inductance is relatively small. In the next circuit the capacity is relatively smaller and the inductance relatively greater, and so on in each succeeding circuit the capacity becomes relatively smaller, while the inductance becomes relatively greater, the product of the capacity and inductance being the same for each circuit. Referring to the accompanying diagram, A



Wireless Telegraph System.

represents the usual aerial conductor of a wireless signaling system, between which and the earth-plate E is connected the primary P of the transformer. A may however, represent a metallic line conductor of an ordinary telegraphic or signaling system, upon which have been impressed alternating currents of a definite frequency and controlled to represent a signal or message. S represents the secondary of the transformer, and in circuit therewith are the capacity or condenser K′, inductance L′ and the primary P′ of a second transformer. S′ is the secondary associated with the primary P′, and in circuit therewith are the condenser K^2, inductance L^2 and the primary P″ of a third transformer. S″ is the secondary of this third transformer, in circuit with which are the condenser or capacity K^3 and the inductance L^3. The circuits just described are inductively connected with each other in tandem, and, as shown, the capacity of the several circuits becomes progressively smaller, while the inductance becomes progressively greater. The product of capacity and inductance of each circuit is, however, equal to the product of capacity and inductance of every other circuit. The resistance of each circuit is maintained as low as consistent with other requirements. The inductances are shown as adjustable, and, in fact, these inductances are not the entire inductance of a circuit, inasmuch as the primary and secondary windings also constitute a portion of the total inductance of a circuit. The capacities are also adjustable. In shunt to the inductive L^3 is connected the wave-responsive device W′, which controls the usual local circuit including the relay R′ and the source of energy B′. The relay R′ controls the local circuit, including source of energy *b′* and recording device M′. In shunt to the condenser K^3 is the wave-responsive device W, which controls the local circuit embracing the source of energy B and the relay R. The relay R controls a local circuit, including source of energy *b* and recording device M. Condensers *k* are connected between the wave-responsive devices and the inductance L^3 and the condenser K^3 for the purpose of preventing the relay batteries from normally energizing the relays. With the product of the capacity and inductance K′ and L′ being adjusted the circuit including them becomes selective of a certain message or signal represented by electroradiant energy of a definite frequency. This selectivity is, however, not very sharp, because of the relatively great amount of capacity. With the product of the capacity and inductance remaining the same throughout the tandem circuits and progressively increasing the inductance and correspondingly decreasing the capacity the selectivity becomes sharper and sharper. In consequence in the circuit including the inductance L^3 and condenser K^3 the selectivity is the sharpest, and any stray or undesired harmonics will not produce effects in this most sharply selective circuit to produce any false or undesired signal. It is of the essence of the invention, therefore, that the receiving circuits become progressively more sharply selective, to the end that none but the desired electroradiant energy shall be able to influence the receiving apparatus.

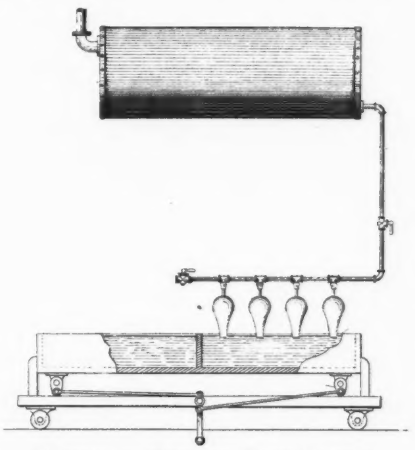
Dr. Georg Egley, a German chemist, residing in Charlottenburg, Germany, has devised a new process of smelting metals and metal compounds by means of electricity. In the reduction of metals in the electrical furnace, especially in the preparation of nickel by reduction of protoxide of nickel in the electrical furnace in presence of carbon, the molten metal easily takes up carbon from the electrodes, thereby appreciably diminishing the value of the product. According to the present invention this inconvenience is avoided by the formation of a scoria of almost two centimetres thickness. This slag or scoria is composed of a substance which is chemically inert or undecomposable to as high a degree as possible at high temperatures and in the presence of carbon and metals which will not melt or which melt only with great difficulty at the temperatures at which the reduction of the nickel oxide takes place and is volatile only to a very small extent and which at the same time is a good conductor of electricity. Under this invention a scoria or slag of this nature is formed over the lower electrode of an electrical smelting furnace previous to the smelting operation, and the fact that the same will remain solid or nearly solid at the melting temperatures will enable it to remain over the said electrode, and thus screen the metal formed at the reduction process against the absorption of carbon from the said electrode. Magnesia is a substance especially well fitted for the formation of



Electrical Furnace.

such a scoria, being indifferent to high temperatures to a remarkable degree. The invention, therefore, adds to magnesia a substance conducting electricity in a cold state or at red heat and which is chemically inert and non-volatile and undecomposable at high temperatures—such, for example, as fluorspar, titanium dioxide, titanium monoxide, or the like. Admixtures of this nature materially add to the conductivity of the magnesia without lowering the melting point of the mixtures below the heat to which they are subjected in the smelting operation. The proportions in which these admixtures are added to the magnesia are about twenty to twenty-five per cent by weight. After the lower electrode, which in the case of continuous currents is the cathode, is covered by a scoria of the nature described, it is allowed to cool to red heat, and then the reduction of the protoxide of nickel is carried out, preferably, by continuous current of low density. The current density employed is preferably about two amperes to the square centimetre, although good results may also be obtained at lower current densities.

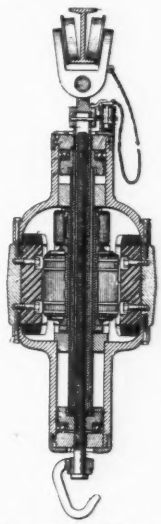
A new method of frosting glass bulbs or globes has been devised by Mr. Patrick Kennedy, of New York city, who has assigned his entire interest to the Con-



Method of Frosting Glass Globes.

solidated Railway Electric Lighting and Equipment Company. The object and purpose of the present invention are to produce on the inner surface of the bulb a frosted appearance, which may cover the whole of the said inner surface or only a part thereof, as will be hereinafter explained. To effect this object according to the present invention the upright bulb is charged through its lower tubular stem with an etching or corroding acid—as hydrofluoric acid, for example—by pressure on the body of said acid, and after it shall have produced the desired effect by corroding or etching the inner surface of the hollow bulb the acid is allowed to flow out by gravity, the pressure being balanced or removed. In order to cleanse the bulb thoroughly of the acid, the above operation is repeated with water, which rinses out the bulb. This result may be effected by immersing the lower stems or necks of the bulbs in the acid or liquid in a closed receptacle and putting air pressure on the liquid, so as to cause it to rise in the bulbs to the desired extent, or it may be done by using an open liquid receptacle and exhausting the air from the bulbs at their upper stems.

The General Electric Company has purchased a patent recently granted to Mr. Augustus A. Ball, Jr., of Lynn, Mass., on a hoisting motor. This inven-



Hoisting Motor.

tion relates to hoisting apparatus, and its object is to provide a simple, compact and powerful machine of this class driven by an electric motor and comprising a self-contained piece of mechanism which can be moved about from place to place whenever wanted. Such a device is of special value in machine shops, where it can be mounted on an overhead track and used to hoist and convey heavy castings and the like from one point to another; in warehouses for lifting and transporting goods; in plants for handling ore, coal, grain; in quarries, dockyards and, in fact, almost every place where things have to be lifted and moved about. The machine comprises a screw which is attached to any suitable abutment, such as a rope, bar, beam or a trolley running on an overhead track, and in such a manner that while it may swing or rotate in any direction it will resist the end pull of the hoist. Concentric with this screw is an electric motor whose armature shaft is hollow to encircle the screw and carries a nut meshing therewith. As the motor revolves it travels up or down on the screw. To increase its range of lift, the screw may be made tubular and the armature shaft may carry a second nut meshing with a solid screw rod sliding in and out of the tubular screw and arranged to be moved upward at the same time that the motor rises and to run downward when the motor lowers itself. This compound screw action gives a range of hoist preferably about double the travel of the motor. An automatic switch cuts out the motor when the hoist reaches the limit of its upward or downward movement.

BOOK REVIEWS.

"Radium." William J. Hammer. New York. D. Van Nostrand Company. Cloth. 72 pages. 6 by 9 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.00.

This is a reprint of a lecture delivered at the joint meeting of the American Institute of Electrical Engineers and the American Electrochemical Society. The author reviews the present state of our knowledge of radium and other radio-active substances, polonium, actinium and thorium. He takes up the subjects of phosphorescent substances and fluorescent substances, the properties and applications of selenium, and the treatment of disease by the ultra-violet light. Certain of the suggested applications of selenium are ingenious and interesting, and the description of the Finsen method of treating skin diseases shows what has already been accomplished and indicates what may be expected of light as a weapon against disease.

"Secondary Batteries." An Engineer. London. Alabaster, Gatehouse & Company. Cloth. 83 pages. 5½ by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.25.

This little work is intended—so the front page informs us—as "a practical handbook for owners and attendants." While there is some good and helpful information in the book of the character that will be understood by the general run of battery attendants, there is a distressing lack of explanatory diagrams and figures, the methods of expressing the ideas set forth are crude, and the work is marred by its inconsequential character and absence of any regular order. Apparently the author simply put down ideas as they occurred and never rearranged them under any divisions or subjects. However, it is, in spite of its faults, a good book for station men in charge of batteries to read and to follow, the matter being fairly reliable and trustworthy. The author insists throughout on the constant attention that should be given cells and on the absurdity of setting down records which do not represent actual observations. While this may appear axiomatic, it is nevertheless true that many records are merely guesswork and this note of protest shows that "Engineer" has come frequently in contact with such alleged records and has been lead by them into devious and unprofitable deductions.

"Alternate-Current Transformer." F. G. Baum. New York. McGraw Publishing Company. Cloth. 195 pages. 6 by 7¾ inches. 122 figures and diagrams. Supplied by the ELECTRICAL REVIEW at $1.50.

The number of works on the transformer and theory of alternating currents already in existence is so great that there is no room for a work on this subject unless the author has new methods of treatment of the complicated and mind-harassing phenomena that comprise the subject, which treatment helps to make clear in this branch of the art. Mr. Baum's contribution to the present literature is, however, well warranted and his work is a step forward toward the ideal treatise on alternating currents in that he discusses, to a large extent, the physical facts. The ideal work on alternating-current phenomena will, it is hoped, some time appear and will take up the physical side of each question and from the actual phenomena as they appear to the mind's eye, deduce the mathematical formulæ, which after all are merely the quantitative expression of the phenomena. Hitherto all the writers on alternating currents have proceeded the other way and deduced a picture of the physical happenings from the solution of mathematical formulæ. While the work under review does not by any means handle the subject in the rational way indicated, it comes much nearer the mark than any book yet published. There are several good, practical formulæ from which the small and negligible factors have been eliminated, making them short, easily used, and sufficiently accurate for engineering computations. The complete formulæ also appear and nearly all are fully derived, making the mathematical work easy reading. The method of referring all actions in the transformer to the magnetic flux simplifies the general theory of this device and it is also applicable to the induction motor. The chapters on "Representation of Pressure Relations," "Regulation" and "Systematic Design" are particularly good. The other chapters are "Elementary Principles," "Simple Transformer Diagram," "Efficiency," "Testing," "Series and Constant-Current Transformers, Regulators and Compensation Voltmeters," "Transformer Connections," commercial types, and an appendix giving extracts from the underwriters' rules.

Proceedings of the Engineers' Society of Western Pennsylvania.

The May issue of the proceedings of the Engineers' Society of Western Pennsylvania contains the following papers: "Commercial Gases for Power Purposes," by Alexander M. Gow; "Power Economy of the Gas Engine as Influenced by the Fuel," by William P. Flint; "Coal-Handling Machinery and Its Application to Steam Power Plants," by T. F. Webster, and "The Evolution of the Determination of Iron and Ores," by H. M. Craver.

Production of Platinum in 1902.

The report for 1902 to the United States Geological Survey on the production of platinum in 1902 is now in press. The report is in two parts, the first being the report proper, by Dr. Joseph Struthers, and the second being a paper by Professor J. F. Kemp on platinum in the Rambler mine, Wyoming.

The production of platinum from domestic ores in the United States decreased from 1,408 ounces, valued at $27,526, in 1901—the largest output recorded by the Geological Survey since 1880—to ninety-four ounces valued at $1,814, the smallest production since 1893. In connection with the platinum there were also obtained from the ores twenty fine ounces of iridium, as against 253 ounces in 1901. The domestic supply of platinum in recent years has been obtained as a secondary product chiefly from gold placer deposits in Trinity and Shasta counties, California. It is reported that the metal occurs, though not in commercially rich deposits, in many other gold placers of California, as well as in Washington, Oregon, Idaho, Montana, Colorado and Alaska. The Rambler mine, Wyoming, continues to attract attention, and during the year, a considerable quantity of the metal was collected, but not marketed, by the Waratah Minerals Company, at Kerby, near Grants Pass, Josephine County, Ore.

The Russian sources of platinum supply, which furnish about ninety per cent of the total consumption of the world, are comparatively limited. The platinum-bearing ores extend along the eastern watershed of the Ural Mountains in Eastern Perm and along the watershed farther south.

The imports of platinum into the United States during 1902 were valued at $1,987,980 as compared with $1,695,895 in 1901.

Professor Kemp's paper contains a brief description of the situation, topography, and geology of the Rambler mine, which is in Albany County, Wyoming, about forty-five miles southwest of Laramie, near the headwater of Douglas Creek, in the Medicine Bow Mountains; a description of the Rambler dike, and an account of the ore body itself. Great interest was excited late in 1901 and early in 1902 by the finding of the platinum group of metals in the copper ore of the mine and by the separation from the ore of sperrylite, diarsenide of platinum. The metal has not yet been extracted on the commercial scale. The paper is illustrated by a map of the Rambler mine.

Power Developments at Niagara Falls.

It is impossible to appreciate the extent of the power developments going on at Niagara Falls at the present time without a visit to that important industrial centre.

Every one is more or less familiar with the condition of the developments on the American side. The Niagara Falls Power Company will, ere long, have all the machinery in its station No. 2 installed, which will give this company an available output of 105,000 horse-power. The Niagara Falls Hydraulic and Manufacturing Company can deliver about 10,000 horse-power with the machinery already on the ground.

It is on the Canadian side, however, that the greatest developments are going on. Here three separate companies are at work. The Canadian Niagara Power Company, which is allied to the Niagara Falls Power Company, is constructing a plant on the same general plan as that of the latter. The wheel-pit is now about complete, the tunnel has been driven through and is being lined, and part of the hydraulic machinery is being put in place. This wheel-pit will accommodate five 10,000-horse-power units, but by extending the pit the capacity of the station will be doubled.

The second company to start construction on the Canadian side was the Ontario Power Company. This company will convey the water from an inlet further up the river through pipes eighteen feet in diameter, placed underground in a trench. The power-house will be placed below the cliff near the Horseshoe Falls. The units will have an output of 10,000 horse-power each, and the total output of the station, when completed, will be 150,000 horse-power. In addition to this, the Ontario Power Company has been granted the right to draw water from Chippewa Creek sufficient to generate another 150,000 horse-power.

The third company on the Canadian side is the Toronto & Niagara Power Company. The power-house of this company will be erected on what is now the bed of the river. Here a wheel-pit will be excavated, and a tunnel driven to discharge the water below the Horseshoe Falls. The design of this station contemplates an output of 125,000 horse-power.

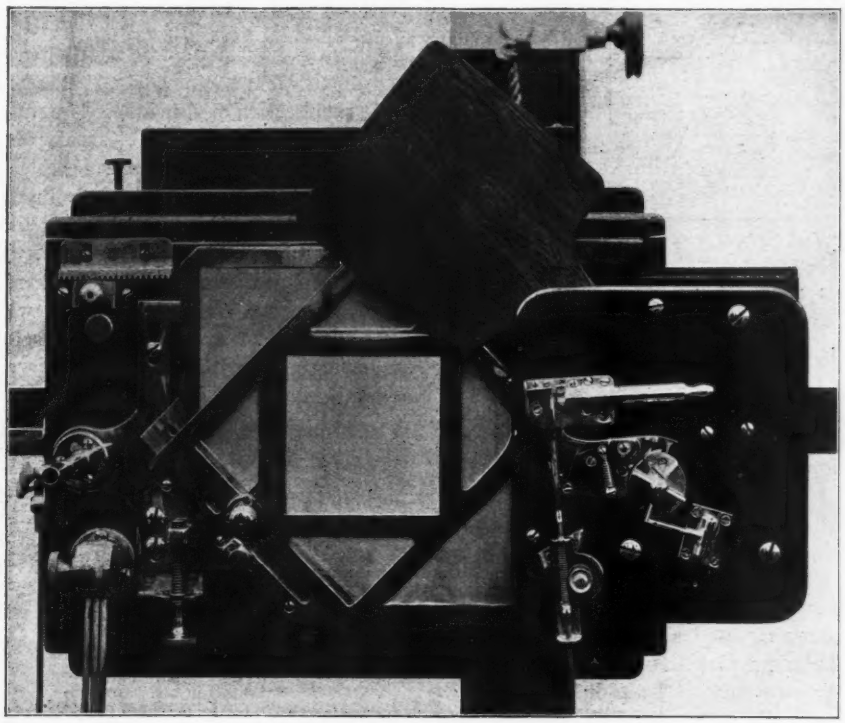


FIG. 1.—SHUTTER FOR X-LIGHT TUBE-BOX, OPEN.

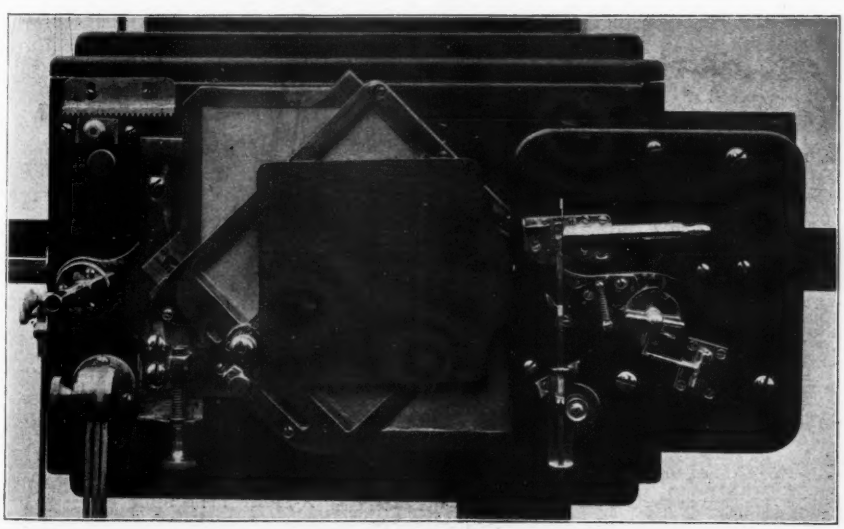


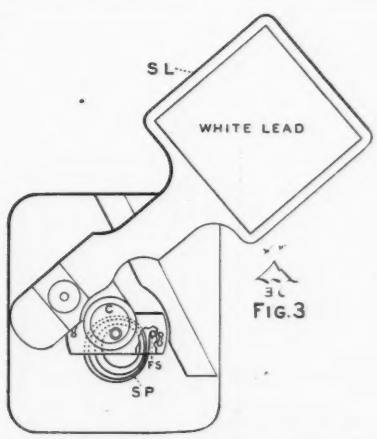
FIG. 2.—SHUTTER FOR X-LIGHT TUBE-BOX, CLOSED.

NOTES ON X-LIGHT.

BY WILLIAM ROLLINS.

NOTE CLXIX—A SHUTTER FOR AN X-LIGHT TUBE-BOX.

In earlier notes I have explained the advantage of using a shutter in taking photographs by X-light and given figures of shutters; the one to be described is a more convenient form. Figs. 1 and 2 are photographs of the shutter. Fig. 1 is a detailed front view of the tube-box slide (consult notes cxlix, clv and clvi), with the opening of the diaphragm plate exposed by the action of the shutter. Fig. 2 shows the same opening closed so that no X-light may escape from the tube-box. Figs. 3, 4, 5, 6 and 7 are drawings



BACK OF SHUTTER FOR X-LIGHT TUBE-BOX.

to explain the mechanism. Fig. 3 is a view of the back of the shutter, the slide of the tube-box having been removed. The leaf SL which closes the hole in the diaphragm plate is made of hardwood with a depression filled with white lead

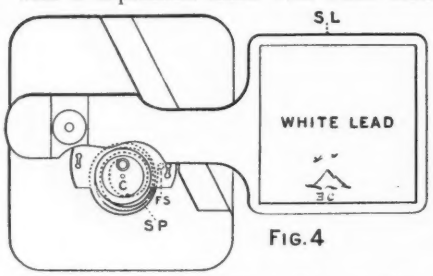


FIG. 4

SPIRAL SPRING FOR MOVING X-LIGHT TUBE-BOX SHUTTER.

and japan until opaque to X-light. The moving force is a strong spiral spring SP, Figs. 3 and 4. One end is attached to the axis of the cam C, which moves the leaf SL, the other to the fixed support FS, attached to the hard rubber plate supporting the mechanism of the shutter. Tension is made on the spring by turning the handle forming the head of the axis of the cam; shown in Figs. 5, 6 and 7. To prevent the action of the shutter from uncoiling more than one turn of the spring in closing the opening of the diaphragm plate, a stop ST is employed, Figs. 5, 6 and 7. To allow the spring to be wound to the proper tension the stop is turned back as shown by the dotted lines in Fig. 5. The shutter is ready for use (with the leaf SL closing the opening in the diaphragm plate), when the hook HK, Fig. 5, is in the very shallow notch NH. To open the hole in the diaphragm

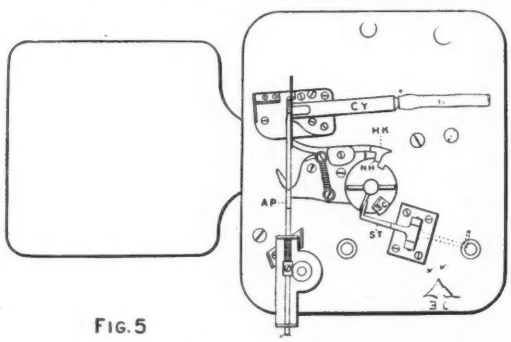


FIG. 5

DETAILS OF SPRING MECHANISM FOR X-LIGHT TUBE SHUTTER.

plate a rubber bulb attached to the rubber tube RT, Fig. 5, is pressed. The air which is driven from the bulb enters the metal cylinder CY, forcing forward a piston that by the force of its impact drives forward the arm AP to the position shown in Fig. 6, releasing the hook HK from the notch NH, thus allowing the spiral spring to turn the leaf SL until the opening of the diaphragm, Fig. 1, is exposed. The hook HK, Fig. 6, strikes against the catch SC, causing the opening of the diaphragm plate to remain exposed. To close the opening in the diaphragm plate, to shut off the beam of X-light, a second impulse is given to the bulb, which forces the arm AP forward to the position shown in Fig. 7, lifting the hook HK from the notch SC, Fig. 6, allowing the leaf SL to close the opening in the diaphragm plate. When a more rapid action of the shutter is wanted the catch SC is turned up by means of a hanger. One impulse of the rubber bulb will then open and close the hole in the diaphragm plate. I have illustrated this shutter with care to make the construction so evident that an ordinary mechanic could make one for any physician who was convinced of its utility. It is useful in photographing the chest and is well

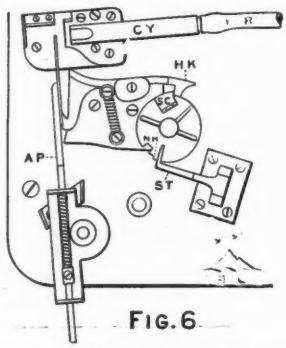


FIG. 6

POSITION OF MECHANISM WHEN OPENING X-LIGHT TUBE SHUTTER.

suited for some therapeutic purposes, especially in tube-boxes containing X-light tubes of the type described in note clxviii and used in treating two patients at one time. In the latter case the tube-box requires two shutters.

Chlorine Smelting with Electrolysis.

At the recent meeting of the Faraday Society, Mr. J. Swinburne described the new method of working sulphide ores, which he has developed in conjunction with Mr. Ashcroft. Essentially, the process consists in attacking simple or mixed metallic sulphide in a state of fusion with chlorine, whereby, under suitable conditions, sulphur is given off and may be condensed, leaving a simple or mixed chloride of the original metals. This chloride residue is then treated by chemical means, all its metallic constituents being eventually displaced by zinc, until the final zinc chloride is ready to be dissociated by igneous electrolysis, giving the chlorine required to treat a further quantity of ore. The method recovers all the ingredients of the mineral as elements, except the iron and manganese, which are obtained as their highest oxides. The former may be further treated to render it salable as an oxide paint, or may be reduced to yield pure iron. The only reagent needed is zinc chloride, zinc itself, or hydrochloric acid, as the case may be.

The application of this process to the Broken Hill ores was explained. The ore is crushed and introduced into a ten-ton transformer which is an iron vessel lined with fire clay. Chlorine is led in at the base through a carbon tuyere, the main gas pipes being of iron. Exothermic decomposition takes place, rendering artificial heating unnecessary. The temperature is controlled by feeding the ore at the proper speed. By means of a chimney the vaporized sulphur is drawn to a condensing chamber, where it is deposited as a solid. The chlorine is pumped in at a pressure of ten to fifteen pounds per square inch. At the end of the operation the ore melts and the gangue separates, usually floating. The ore is then run into water and filter-pressed, the solution being as concentrated as the cloths will bear. In the press remain the gangue and the lead and silver chlorides, the former is separated, the latter is fused with lead to extract silver and any gold. The filtrate is treated with spongy copper to precipitate any lead and silver in solution; with zinc, to throw out the copper; with chlorine, to convert the iron into a ferric state, whence it is precipitated as hydroxide and zinc oxide. Thus, an aqueous solution of pure zinc chloride is left, which is cautiously evaporated to dryness, and the residue fused. This is decomposed electrolytically in open vats where cheap anodes are used, before the bulk of the pure chloride is dissociated. The fused zinc chloride derived from the lead sub-

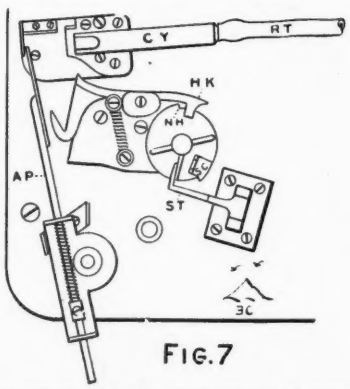


FIG. 7

POSITION OF MECHANISM WHEN CLOSING X-LIGHT TUBE SHUTTER.

stitution above is then incorporated with the rest of the salt, and the whole is electrolysed with a current of about four volts in closed vessels internally heated, which are kept under a slightly diminished atmospheric pressure to prevent loss of chlorine. The cost of working the process is given roughly as $7.50 per ton, over and above the cost of electrical energy.

High-Speed Electric Traction on Railways.

At the recent conference of the British Institution of Civil Engineers a paper upon high-speed electric traction was read by Mr. J. W. Jacomb-Hood. High-speed electric service is defined as "frequent communication, without intermediate stops, between busy centres that are widely separated." The speed of the trains must not be less than sixty miles an hour. Means that are adopted for such high-speed services must be equally available for a modified stopping service, as well as for freight and shunting services. While the advantages of electrical service are admittedly considerable for many conditions of traffic, a wholesale conversion of steam services is so difficult a financial problem as to be practically impossible even if proved desirable. The subject divides itself into generation, consumption, transmission, distribution and collection of current. One of the vital questions connected with the power station is the economical limits of size of steam or gas generating units. After taking account of the increased cost and losses in extended transmission lines, reason would seem to dictate that the power stations should be as widely separated and as few in number as possible, to ensure a steadier load and a better load-factor. As regards driving motors, the practice of to-day seems to be in favor of a direct-current, series-wound motor with automatic field regulation. On the other hand, there is the alternative of a system that involves the use of smaller high-tension currents used in alternating, single or multiphase motors that are limited to one or two economical speeds. It is difficult to foresee the effect that invariable speed would have upon the conduct of general railway business. For all classes of work, variable speed is to be preferred. The multiple-unit system will almost certainly be employed for high-speed service, while electric locomotives will be used for freight shunting and other general business. In the transmission, distribution and collection of current the greatest practical difficulties are met. The urgent need for economy makes overhead bare conductors suitable for carrying current at high voltage desirable. Existing practice seems to show that a system of distribution to a third conductor rail best meets the needs of the case, but the existence of a third rail introduces troubles in the up-keep of the road and should be avoided if possible. An overhead conductor system will be less unwelcome to the maintenance engineer and, from some points of view, has advantages over any ground-collecting system. But if three-phase current is used the duplication of conductors presents another difficulty. Difficulties in the way of collecting comparatively heavy current from an overhead equipment appear to have been solved to some extent in the North Italian railways. Systems that have been advocated of collection from the primary conductor for use in a motor-generator on a locomotive seem attractive, as they would do away with substation difficulties. Further accumulator systems, though they may be useful and economical for light branch services, are thought to have any promise for heavy general railway work.

Automatic Control of Electric Cars.

Recently a demonstration was made at Devonport, England, of a new system of regenerative tram-car control which has been designed by Mr. J. S. Raworth. The car had four wheels and weighed about nine tons. It was equipped with two 1,000A Brush motors. The line upon which it was tried has a number of steep grades, varying up to ten per cent. The total length of level road does not exceed one-quarter of a mile in five miles. All the cars have been equipped with hand brakes, slipper brakes and rheostatic brakes, but in spite of these precautions a number of serious accidents have happened.

The alternations made in the equipment are as follows: The field winding has been changed from series to shunt, with the addition of an auxiliary series winding. The motion of the power handle has been limited to the series notches. A speed control lever has been added, interlocked with the power lever, and an automatic switch has been introduced into the emergency circuit to cut out resistances when the line current fails. No change has been made in the armatures or any other connections. Power is applied by the power handle as heretofore, but more quickly. This gives the car a speed of from two and one-half to three miles an hour. The speed lever is now pushed forward slowly for acceleration up to fourteen miles an hour. Regeneration takes place automatically on a descending grade by pulling back the speed lever quickly.

In descending a one to twelve grade the speed lever can hold the car steadily at two and one-half to three miles an hour. In the extreme backward position the speed lever releases the power handle, which instantly flies to the emergency stop and pulls the car up, without any shock, to one mile an hour. The effect is exactly the same whether the trolley be on or off the line. In climbing a hill the effect of shutting off the current is that the car drifts slowly backward at one mile an hour.

The net saving in energy obtained in a large number of trial runs is stated to be about thirty per cent, as measured on the car. Instead of 140 amperes, the maximum demand on the line is reduced to eighty amperes per car. In descending hills the regenerative effect is usually forty amperes, though it sometimes rises to fifty amperes. There is no heating or sparking of the motors beyond normal. Mechanical brakes are superfluous, except to hold the car on the grade. The regenerative control is said to be quicker and more certain in braking than any of the brakes with which cars are now fitted.

There are two handles on the controller —one for the field winding and the other for the armature. The latter can not be moved until the former is on the notch of the maximum excitation of the field, but it can then be advanced to any position. Resistance is gradually inserted into the field circuit to increase the speed by advancing the lever controlling the field resistances. Should it be desired to decrease the speed or to cause the motors to generate and return current to the line, it is only necessary to move this lever backward. When this lever reaches a position in which all resistance has been cut out, the armature lever flies back and breaks the circuit, unless it is purposely held forward. As shunt motors are used, current is returned to the line automatically when the car descends a grade. If the trolley comes off the line the motorman has merely to press a small handle attached to the field resistance lever, which switches in a series winding system of many turns of fine wire and short-circuits the motor. It is immaterial in what position either lever is, or whether the car is running backward or forward when this operation is performed. Immediately the auxiliary series winding is connected, the car is pulled up almost to a standstill. The inventor states that it is possible to combine his system with the series parallel, and in this way obtain an acceleration as great as that given by the latter system.

There are several varieties of mica, some of which have commercial value when in merchantable condition. The most common is muscovite, or potash, mica. This is the ordinary mica of commerce. By transmitted light it is various shades of yellow, green and brown, wine color, etc.

Reviews of Current Engineering and Scientific Literature.

Metallurgy of Zinc.

In this article Mr. J. Izart discusses the various metallurgical processes for the production of zinc. A review is given of the different electrolytic processes, none of which, however, is thought to meet the requirements. The difficulties encountered in most of these are those of producing the zinc in a solid metallic form and purifying the electrolyte. Zinc, however, can be produced in a solid deposit with very heavy current densities at low temperatures, but the consumption of energy and the high counterelectromotive force of polarization are given as the reasons why the electrolytic method has not replaced the older methods.—*Translated and abstracted from the Revue Technologique (Paris), June* 30.

The Heat Absorbed in the Electrolysis of Silver Salts and the Principle of Maximum Work.

When a solution contains one part of silver nitrate and proportions varying from one to thirty-two of nitrate of copper for a hundred parts of water, the copper nitrate does not begin to decompose until the solution contains about thirty parts of copper to two of silver. By increasing the proportion of copper, a point is finally reached where the deposit contains one part of copper to two of silver. Where the solution contains eighty-seven parts of copper nitrate to two of silver nitrate, the deposit contains metals in equal proportions. According to Sprague's law, the silver nitrate should be decomposed first, followed by the copper salt, because the heat of the combination of copper nitrate is 52.3 calories and that of the silver is 17.4. If an acidulated solution of hydrogen peroxide is electrolyzed, hydrogen is given off and water is decomposed, but the peroxide is not reduced, although sixty-nine calories are required to bring about the former reaction, while the latter sets free 21.6 calories. These and other similar reactions have caused M. de Tommasi to state the following laws: "If a body is submitted to two chemical actions, that reaction which disengages the greater quantity of energy will take place, provided it can be started. Between two chemical reactions, that which requires the least heat or energy to start it will take place, even if it sets free less heat than the other reaction." The author then enunciates the following law, which he calls "the principle of minimum work": Of several possible chemical reactions that which requires the least energy to start it will take place, whatever the quantity of heat of reaction, if it be started."—*Translated and abstracted from l'Electricien (Paris), July* 18.

The Magnetic Rotation of the Plane of Polarization.

From his magnetic-optical theory, Voight predicted that exceptional rotation of the plane of polarization in the neighborhood of an absorption band would take place under the influence of a magnetic field. Mocaluso and Cordino have verified this deduction experimentally. Voight also stated that certain phenomena would be present, and this also was verified. In this article Herr J. J. Hallo explains the method used in this work, by which the quantitative law has been deduced. Light polarized by means of a Nicol prism was passed, first, through the axis of a Ruhmkorff coil, between the pole-shoes of which was a sodium flame. The light then passed through a Fresnel double quartz prism which was placed before the slit of a spectroscope. Immediately back of the slit was the analyzing Nicol prism. The slit was placed at the focus of a concave mirror, which threw the rays in this way made parallel upon a large Rowland grating. The spectrum thus obtained is stigmatic and, in consequence, the double quartz prism gives in the spectrum a system of horizontal alternating dark and bright bands. As soon as the magnet is excited, the bands in the neighborhood of the sodium absorption band are shifted in consequence of the rotation of the plane of polarization. The part of the spectrum in which the sodium lines are found is photographed, and this photograph is later enlarged five to seven times. On this photograph two rectangular axes are laid off, the axis of abscissa being parallel to the interference bands, and the axis of ordinates parallel to the absorption bands. The axis of abscissa is divided into half millimetre divisions, and the corresponding ordinate of the interference band for each of these points is read off. On each photograph the author found three interference bands, and the sum of their respective ordinates was taken as the mean. The deviation of a band from its original position at each point gives the rotation of the plane of polarization at this point. The results of one experiment are given and their application explained.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), July* 15.

A New Detinning Process.

A new process of separating tin from tin scrap has been devised by Twnyan, which differs from those hitherto proposed, as voltaic action, aided by atmospheric oxygen, is made use of. Coke is crushed to a coarse powder and saturated with a strong solution of common salt. Any excess of solution above that required to saturate the coke is drained off, as it is important that air should be able to penetrate readily through the mass. The scrap to be stripped may be placed in any receptacle or even piled upon the ground. It is covered with this coke powder. Action commences rapidly and is completed in a few hours. The pile of scrap should be stirred from time to time to bring all parts in contact with the coke. The scrap iron is then screened from the crushed coke, which is allowed to fall upon a fresh pile of scrap tin. The iron is washed to secure the tin, which forms a white, milky precipitate in water, probably hydrated stannic oxide. No tin is found in solution as chloride. The moistened coke can be used over and over again, as long as it does not become too dry. The coke is not washed to secure the tin until sufficient is contained in the heap to make it worth while to clean up. The process is applicable to scrap of all sorts and all shapes, and it is said that a fairly complete separation of the tin is obtained at a very cheap rate.—*Abstracted from the Electrochemist and Metallurgist (London), July.*

Electric Power Appliances in the Mines of Europe.

There are few departments of engineering in which electricity renders more efficient aid than it does in the operation of a mine. In this article M. Emil Guarini gives a general survey of the field from the viewpoint of Continental practice. The disadvantages of the older systems were such that as soon as the possibilities of the application of electricity to mining were realized the field was actively entered by many large electric companies. The advantages of this power are, of course, the ease of transmission, the high efficiency, the conductors are readily

placed, the machinery is easy to operate, requires little attention and is reliable. In addition, the power station may be placed at the most advantageous position for economical running, there is no loss of energy when the machine is not in operation, and the total number of employés may be considerably reduced. While many Continental mines are electrically equipped, the author states that so far as he knows there is none which is operated throughout solely by electricity. Nevertheless, every phase of work about the mine can advantageously make use of it—lighting, signaling, hoisting, drifting, ventilation, hauling and tramming, firing of shocks, the surface work, and ore treatment. In all of these operations electricity is a valuable and economical auxiliary, because no other agent lends itself so well to the requirements of the industry, the unavoidable losses are minimized, and the means are seldom wanting for the cheap generation of electric power in a mine. In the choice of the type of motor to be used—whether direct or alternating current—both sides have their advocates and there are many excellent installations of both types. The author explains the various uses to which electricity may be put and the means for controlling the machinery, the types of generating stations which have been installed, and the accessory apparatus. The telegraphic systems which have been developed for mine use are interesting. Each station is usually provided with a transmitter and a receiver. The receiver consists of a voltmeter, around the dial of which are arranged a number of signals or orders. The operator transmitting the order turns the crank of a magneto machine until the handle of the transmitter dial reaches the signal desired. The same signal is indicated on the receiver dial, and is usually accompanied by as many strokes of the bell as the needle has advanced degrees. The operator receiving the signal repeats it back to the sender. A small dial and a short needle permit the transmission of quite a number of signals. The telephone instruments are usually loud-speaking, the receivers and transmitters proper being closed by rubber stops when not in use. In noisy places the telephones are usually provided with movable receiver tubes which are drawn forward and adjusted to the ears. A series of push-buttons serves to keep the telephone in circuit with the various lines. A great deal of mine signaling is done by simple sounders. For this service two bare wires are run from the signal bell at the hauling engine through the gallery where the trams run. A piece of metal of any sort serves to complete the circuit at any point. The electrical transmission of signals promotes safety, makes the transmission of orders rapid, and establishes a bond between the various parts of the mine and the office of the mine's manager.—*Abstracted from the Engineering Magazine (New York), August.*

New Electricity Works of the Manchester Corporation, England.

In this number of this series of articles describing the generating stations of the Manchester Corporation, the Bloom street station is taken up. This station is practically an extension of the original Dickinson street station, from which it is separated by an arm of the canal. It was erected mainly for the purpose of supplying power to the tramways, and presents a case where a power station is designed and completely equipped from the very start, there being no possibility of extension on this site. This site is trapezoidal in shape, and the boiler room makes an angle with the engine room. The site is bounded on two sides by the canal and upon the other two by two streets. The power-house measures 172 feet by 36 feet, and contains eleven Babcock & Wilcox boilers set in six batteries. Each boiler is capable of evaporating 18,000 pounds of water per hour normally superheated 100 degrees Fahrenheit. The boilers are fitted with chain-grate stokers, and over each boiler is a Green economizer. Above the economizers are the feed-water tanks, and over all are the coal bunkers. These are capable of holding 800 tons of coal, which is brought into the works in wooden boxes, as is customary in that section, lifted by a crane which runs along the top of the bunkers, and dumped into the bunker where it is required. The engine room measures 150 by 44 feet and is 36 feet 6 inches high to the crane rails. The generating plant consists of four Musgrave-Westinghouse steam dynamos, each giving normally 1,800 kilowatts at seventy-five revolutions per minute. The engines are vertical, cross-compound, condensing engines with Corliss trip-valve gear driven by separate eccentrics. Provision is made for controlling the valve gear of both cylinders by means of the governor, but it is customary to control the high-pressure cylinder only, operating the low-pressure cylinder at a fixed cutoff. The generators are large twenty-pole machines with a drum-wound armature and a commutator consisting of 900 segments. The field frames are split vertically and are compound-wound. The machines supply current at 410 to 440 volts for lighting, or 500 to 550 volts for traction. When used on a lighting load they are operated as shunt machines only, but as compound machines for the traction load. Each engine is provided with a separate surface condenser, the circulating pumps of which are driven by electric motors. The plant is connected to the Dickinson plant across the canal by means of cables carried in troughing over a gangway.—*Abstracted from the Electrical Review (London), July 17.*

The Sterilization of Water by Oxygen Compounds of Chlorine.

In this article Dr. Edouard Imbeaux describes the ozone sterilizing plants of Weisbaden-Schierstein and of Paderborn, a description of which has already appeared in the ELECTRICAL REVIEW. The author then takes up the sterilization of water by the oxygen compounds of chlorine. This method is interesting, as the chemical (bleaching powder) is a by-product of certain electrochemical processes. A process was developed by Bergé, in which the peroxide of chlorine was produced by treating potassium chlorate with sulphuric acid, but this has never found application, as the method is extremely dangerous. A process free from this fault is due to M. Howatson. In this, bleaching powder and perchloride of iron are brought together in solution. This gives calcium chloride, ferric oxide and peroxide of chlorine, the latter acting as the oxidizing agent. The apparatus consists of two metallic towers containing each a double layer of sand, which acts as a filter. The lower layer is of coarse sand with the grains from three to four millimetres in diameter. This is thirty centimetres thick. The next layer is of equal thickness of sand with grains of about one millimetre in diameter. Over the two towers are the tanks containing the oxidizing reagent. From these tanks the reagent is allowed to drip into the pipe which delivers the water to the filters. The oxide of iron formed is deposited in a layer over the surface of the sand and arrests all solid matter and inorganic matter destroyed by the reaction. The operation of this apparatus is rapid and regular. It should be cleansed daily by forcing a current of water through the filter in the reverse direction. A filter four metres in diameter will sterilize about a thousand cubic metres of water per day.—*Translated and abstracted from la Revue Technique (Paris), July 10.*

THE SITUATION REGARDING THE EDISON STORAGE BATTERY.

A VISIT AND INTERVIEW WITH THE INVENTOR AT HIS LABORATORY.

Any information regarding the Edison storage battery is read with interest, and with the idea of seeing whether there was anything new to be said on this subject, a representative of the ELECTRICAL REVIEW called upon Thomas A. Edison last week at his laboratory at West Orange, N. J. Mr. Edison was very busy at the time with one of the phonographs used in making the master records. This machine was misbehaving, and tests were being made to locate the trouble. After making a record from a grand piano, which was played for this purpose by an electric piano player, Mr. Edison passed the record through a phonograph and listened to it for some time. He then placed it under a microscope and examined it for mechanical defects.

"You know," he said, "there is nothing like a phonograph for giving trouble. The storage battery is nothing to it. That record is out less than the one ten-thousandth of an inch, but it is worthless. Now listen to this one," he said, placing a moulded record in the machine. The piece was a duet and was certainly very fine. "Pretty good, isn't it," said Mr. Edison, with a smile of satisfaction.

When asked whether he had made any recent tests with his electrical automobiles, he said: "I have made some automobile tests recently, but these were purely automobile tests, and not battery tests. We secured a large twenty-four-horse-power gasoline tonneau and took it out to see what it could do. We wanted to get some data for designing several machines for our own use. We ran this machine for all it was worth, and by the end of the run all of us were nearly in a state of nervous prostration, and many times it looked as though we would never get home again. We took it over rough roads and up hills and down, and in places we made about forty miles an hour; but I don't want to do it again. Talk about eighty miles an hour—Whew! I don't want to try it. Why, when we turned a sharp corner I thought every time the machine was going over; and when we finally did pull into the yard I didn't have strength enough to lift my cigar. But we got the data all right. Look here," he said, picking up a small red leather-covered notebook, "this is automobile data." He turned over a number of pages upon which there were tables and notes. A pocket at the back of the book contained a number of curves showing the results of the tests.

"That is all automobile data," he said, "and I am going to build a good machine. The machines built in this country are too amateurish and are not at all up to the best French machines. In fact, the French builders are three or four years ahead of the builders in America. For instance, the necessity of making the steering gear strong enough is just being recognized in this country. The French machines are much stronger than the American machines, although our roads are far worse than theirs."

"You are not going in for high-speed machines, are you?"

"No," said Mr. Edison, "I have had enough of that. These machines will be geared for twenty-five miles an hour, and they will make it right along. I believe that with one of these machines I will be able to beat, or, at any rate, keep up with any gasoline machine on a long run. If they run faster than my machine on a level, I will be able to go down hill just as fast as they will dare to, and for hill climbing, the electric motor is just the thing, so I will beat them there. On rough roads they will not dare to go any faster than I will; and when it comes to sandy places, I am going to put in a gear of four to one which I can throw in under such circumstances, and which will give me 120 horse-power of torque, and I will go right through that sand and leave them away behind! If the gasoline machine is stopped for any reason at all I will beat it easily. If they have no trouble whatever they may possibly beat me, though I doubt it. My machine will not break down at all."

When asked the condition of the storage battery, Mr. Edison said that they were turning them out and selling them at present.

"We are now making one set a day, and within a short time will be making two sets. We are not doing any advertising, because we have more orders than we can begin to fill. One large responsible automobile company offered to take all that we could make. The public doesn't seem to understand that it takes time to develop an invention. If there were nothing to be done except to invent the battery it would be easy, but it is when it comes to designing and making the machinery for turning out the battery in commercial form and quantities that it takes time and money. We had a good battery last fall and had the machinery for making it, but I found a method by which I could reduce the time for charging very greatly, and this necessitated the remodeling of all the machinery; but it had to be done. Why, it took six years to put the incandescent light on a commercial basis; it took eight years to develop a practical telephone, and it has taken sixteen years to make a satisfactory phonograph and nine years for the typewriter. But the public doesn't realize that, and think that as soon as a machine is invented it should be put on the market. Another thing that has held me back has been the difficulty in getting the kind of steel plate we need. We can get it all right, but we have to import it and pay a heavy duty. It is now being rolled in small quantities in this country by one firm, but machinery is being put in as fast as possible, so that we expect to have a satisfactory supply some time in the fall."

"The new battery, then, is much better than your old one, Mr. Edison?"

"It is better in that it has a higher charging rate. You can charge it within one hour enough to give seventy-five per cent of its total capacity. In fact, the battery for large delivery trucks can be charged sufficiently while the trucks are being loaded to enable them to deliver their goods. This, of course, means practically an unlimited travel. There is one truck now operating in New York, owned by B. Altman & Company. It is a two-ton truck, and had formerly something over 1,200 pounds of lead battery. We put in 1,200 pounds of my battery some time ago, and before long found that this battery was unnecessarily large. The man in charge decided to take out some of the cells. He took out one-half of them, I believe, leaving about thirty-six out of the sixty-six, calculating that this ought to give him a range of twenty-five miles, though he had some misgivings and thought it advisable to give it a thorough test for capacity before sending it out. He started out from the barn and began to circle around Central Park. He had figured out that he could make the twenty-five miles before six o'clock and keep an engagement which he had, but when six o'clock came the battery showed no signs of falling off, so he kept it going. He made twenty-five miles, thirty, thirty-five miles, and then he decided to take the truck back to the barn. At the end of the run he had made 36.8 miles, and the batteries were just beginning to show a falling off in voltage. He had only something over 600 pounds of battery in that two-ton truck, and that gave him a range of travel of thirty-five miles."

"Does the battery require much attention?"

"No," said Mr. Edison, "it doesn't require any attention beyond seeing that the cells are kept full of water. You would think that any one would know enough to keep the cells full of water, particularly when a card is furnished with instructions to do so, but we had an experience with one man who was told to fill the cells from time to time, and who was not told to do anything else; but still he didn't do it. Of course, the water evaporated, the electrolyte fell, and the capacity of the cells ran down. He began to criticise the batteries, as they did not seem to be doing all that had been claimed for them. When we examined the battery there was only about one-third the volume of electrolyte that there should have been, and yet he thought the cells should give him the full capacity. When we filled them up with water they were all right again, and now we are going to put on each cell, 'keep full of water.'"

When asked whether he was thinking of bringing out a type of cell suitable for railway work, Mr. Edison said that he was satisfied, for the present, at least, to work on the automobile battery. They were very busy filling orders, and the question of adapting the battery to railway work would come later.

He said: "It will be very useful there, particularly in operating extensions to trolley lines already built. The batteries would be an economy in railway work, because a twenty-car system could be operated continuously with twenty-six cars, six cars being charged while the other twenty were on the road. The battery equipment should be a part of each car, and should not be removed. At the end of the trip the car could be run into the shed and charged in one hour sufficiently to keep it on the road three hours. As against the cost of the six additional cars and the batteries, there would be the saving in the transmission line. As yet, we have not detected any deterioration in the cells. Of course, the efficiency of the automobile cell is not as high as would be the case for a battery intended for station work, because other things are sacrificed in order to gain a high charging rate."

When asked whether he thought there would be any difficulty in reaching charging stations when on a tour, Mr. Edison said that he did not think there would be within a short time. Charging stations are now being put in in various parts of the country, and this work will go on more rapidly as soon as there is a demand for current.

He said, however, that he could not understand why every one was going mad on alternating currents. In many cases, the large amounts of copper required in the direct-current system would, in the end, be found to have cost less than the transformers, batteries and the other secondary devices necessary for the alternating system.

In speaking of rectifiers for obtaining direct current for charging from an alternating-current circuit, Mr. Edison recalled his old device in which a third terminal had been introduced into an incandescent lamp. A direct current was obtained from the third wire. But he did not think the device could be made practical.

Mr. Edison is looking very well, but seems to have forgotten that he said last winter he was going to take a long rest. Evidently he can not resist the temptation to grapple with the many problems which arise in his laboratory.

The Power Plant at Hamilton, Canada.

The Hamilton Electric Light and Cataract Power Company's steam power station in Hamilton, Canada, which will be used as an auxiliary to its water power plant at De Cew Falls, thirty-four miles distant, is to be equipped with the following machinery recently ordered from the Westinghouse Electric and Manufacturing Company: Two 1,000-kilowatt, two-phase, 2,400-volt, 8,000-alternation, engine-type generators, each driven by a vertical Corliss engine furnished by the Goldie & McCulloch Company, of Galt, Ontario; one fifty-kilowatt motor-generator exciter set for these alternating current generators, consisting of one seventy-five horse-power, two-phase, 400-volt, type C induction motor and a fifty-kilowatt, 125-volt, compound-wound, engine-type generator, constituting a two-bearing set; also a switchboard consisting of two generator panels. In the receiving station of the Hamilton Light and Power Company, which adjoins the auxiliary steam power station in Hamilton, will be installed six 500-kilowatt, oil-insulated, self-cooling transformers with transformer panels, stepping down the current from 20,000 volts or 40,000 volts, three-phase, to 2,400 volts, two-phase. The engine-type alternators mentioned above will be operated in parallel with the secondaries from these transformers. For the water power station at De Cew Falls, the Westinghouse company will furnish two 5,000-kilowatt, three-phase, 2,400-volt alternators, which will be direct-coupled to water-wheels that are being built in Italy; two 100-kilowatt motor-generator exciter sets, each consisting of a 150-horse-power, 2,400-volt, type C induction motor, and two 100-kilowatt, seventy-volt, direct-current, compound-wound, engine-type generators, constituting three-bearing sets; five 2,500-kilowatt, oil-insulated, water-cooled transformers, transforming from 2,400 volts, three-phase, to 22,500 or 45,000 volts, three-phase; together with the necessary switchboards to control the apparatus recently ordered as well as that already installed in the station, aggregating eight separate switchboards with a total of eighteen panels, these to be equipped with type F instruments and types C and B oil switches throughout.

The North-Eastern Railway System.

Particulars have been given in previous notes of the conversion to electrical working of a section of the North-Eastern Railway Company's system near Newcastle-on-Tyne. The work of equipping the permanent way is to be proceeded with forthwith, and the further details of the scheme herewith will prove interesting. Beyond the addition of the working conductor no alterations will be made to the running road. Experimental trips are anticipated by September next, and when the service is in full running order an average speed of twenty-two miles an hour will be maintained. Two electric locomotives will be employed to work the goods traffic. With regard to the construction of the new passenger cars, the sides of these will be built absolutely perpendicularly, and not sloping as is the case with ordinary steam trains, and the width of nine feet thus obtained will constitute the widest cars in England, of this description. The bodies of the cars will be built at the company's works, and the bogies will also be made in England to the design of the North-Eastern Railway Company's engineer. The approximate length of route—single track—will be eighty miles. The arrangements for the supply of electric power were dealt with in my last notes. While on the question of the conversion of steam roads to electrical working, it may be mentioned that the British Westinghouse Company has just secured the contract for the electrical equipment of the Werral Railway Company's system, which has running power over the Mersey company's lines. The equipment will be identical with that of the Mersey system, power probably being supplied from the same power-house. Mention may also be made of the power-house which has been temporarily erected by the District Railway Company for working the experimental trains, recently described in a separate article in the ELECTRICAL REVIEW. Really the plant is that which was used to operate the notorious experimental line at Earl's Court before the arrival of Mr. Yerkes, at a time when no disagreement existed between the two owners of the Inner Circle. There are two Belliss engines direct coupled to Siemens two-pole compound dynamos which generate at 550 volts. The Babcock & Wilcox boilers work at a steam pressure of 175 pounds. The power-house also contains a 270-cell storage battery.

London, July 25. A. W.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Hot-Wire Voltmeters and Ammeters.

Recognizing the many advantages of hot-wire electrical measuring instruments, the Stanley Electric Manufacturing Company, Pittsfield, Mass., several years ago purchased the patent rights to what this company claims to be the most successful instrument of this character ever produced. Since this time their value has been generally recognized, and over 10,000 of these instruments are now in use in all parts of the world.

The action of a hot-wire instrument

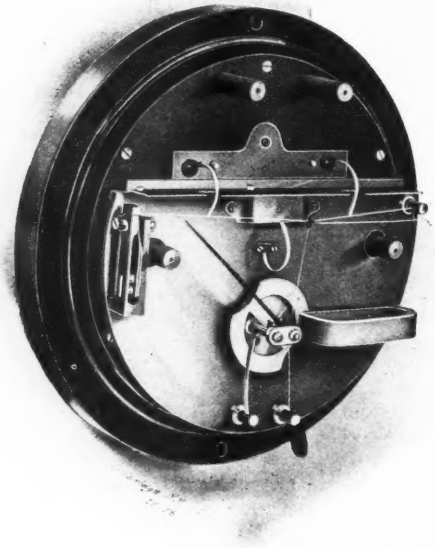


FIG. 1. - HOT-WIRE AMMETER, WITHOUT COVER.

depends, as its name implies, on the elongation of a wire suitably suspended and connected in the circuit, due to the heat produced by the current flowing through it. Owing to the fact that they operate independently of magnetic influences, hot-wire instruments are unaffected by the frequency of the current which they measure or by the wave-form, and they are correct on either direct or alternating-current circuits. Moreover, external magnetic fields due to the proximity of bus-bars, generators, etc., do not influence their action, and this instrument may be mounted wherever convenient.

Fig. 1 shows an "S. K. C." hot-wire ammeter without the case, and the working parts may be clearly seen. The hot wire proper which carries the current is made of platinum-silver, about six inches long, stretched between two terminals. Silver strips furnish auxiliary connections to the hot wire, so that the current has several paths in parallel through the same. Near the centre of the platinum-silver wire there is attached another wire made of phosphor-bronze, running to a terminal at the bottom of the instrument. Branching from the phosphor-bronze wire is a strong fibre, which is looped around a jewel-mounted steel drum carrying the pointer, and terminating in the spring (as shown in the lower left hand of the illustration) which maintains it taut.

It is well known that when a wire is stretched nearly straight between two points, the slightest change in its length causes a considerable change in the amount of slack. On the passage of the current through the platinum-silver wire, its elongation produces a considerable slack in the phosphor-bronze wire, and this slack is immediately taken up by the tension of the steel spring on the fibre, the drum around which the fibre is looped being thereby rotated in proportion to the slack taken up. Owing to this arrangement of the platinum-silver and the phosphor-bronze wires, a very slight change in the length of the hot wire causes the rotation of the drum through a considerable angle, and a scale of the usual dimensions is obtained with a pointer of the usual length. The whole of the hot-wire movement is mounted on a plate made from an alloy whose temperature coefficient is the same as that of the measuring wire. Therefore, the accuracy of the instrument is unaffected by external temperature changes.

These instruments are inherently dead-beat in their action, and the addition of a damping magnet, shown in the illustration, makes them perfect in this respect.

Ammeters for switchboard work are made in two different styles, one in which the working parts are mounted in a hard-rubber case with a plate-glass front, and one in which the working parts are mounted in an iron case.

All ammeters are provided with a short-circuiting switch, such as is shown in Fig. 2, by which the hot wire may be relieved of the current when it is not desired to take readings. Although this switch is in no way necessary to the successful operation of the instrument, it eliminates any possibility of a burn-out through an overload at times when the readings are not needed. Ammeters with a capacity of 100 amperes or less can be provided with an automatic short-circuiting device which comes into play when the instrument is subjected to a heavy overload.

Except in the special instrument de-

FIG. 2.—SHORT-CIRCUITING SWITCH.

signed for very low currents, only a small portion of the current measured passes through the hot wire, the main portion passing through a shunt of low resistance. For the switchboard type of instrument this shunt is external, and can be placed where most convenient. Figs. 3 and 4 illustrate two styles of shunt, the latter

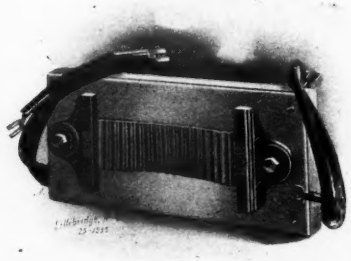


FIG. 3.—AMMETER SHUNT.

being for unusually large currents. Placing the shunt near the mains avoids the necessity of running heavy conductors to the place where the instrument is located. By providing several shunts, the same instrument can be used for widely different currents. In some cases the instrument can be marked with several different scales, or, where the shunts are of a convenient ratio, the proper scale can be

provided for one shunt and the readings multiplied or divided, as the case may be, when other shunts are used. For example, without a shunt the full scale readings may be three amperes; using a shunt, the full scale of the same instrument may be 3,000 amperes. Shunts are ordinarily used with switchboard instruments on circuits not exceeding 3,000 volts. On circuits of over 3,000 volts, a series transformer is used in place of a shunt. By this means the instrument is thoroughly insulated from the line, and the danger of shock to the attendant is eliminated.

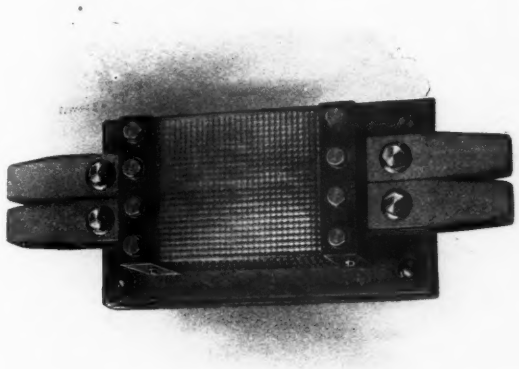


FIG. 4.—AMMETER SHUNT.

There are three types of series transformers. The dry type, shown in Fig. 5, is used on voltages up to 10,000 volts with currents of 15 to 300 amperes, and is very light and compact. This is mounted on a suatable marble base. The oil type, shown in Fig. 6, is mounted in an iron case large enough to give ample room for free circulation of oil about the coils of the transformer, and the mechanical design is such that it can be placed upon the floor or upon suitable brackets. This type is used on voltage from 10,000 to 30,000, with currents up to 200 amperes. The third type, shown in Fig. 7, is used for voltages up to 10,000, with currents from 400 to 1,000 amperes. It is so constructed that it can be mounted directly on the bus-bar, which thus constitutes the primary winding.

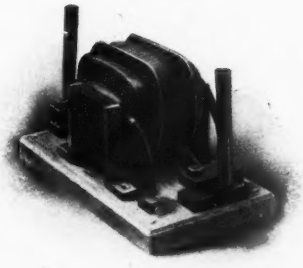


FIG. 5.—SERIES TRANSFORMER, DRY TYPE.

The series transformers furnished with these instruments all have a secondary current up to three amperes, that being the current which the hot wire proper is designed to carry. When instruments are used with series transformers the leads running to the same from the instrument can be made any convenient length.

"S. K. C." hot-wire voltmeters present quite the same appearance as the ammeters. They operate on exactly the same principle and exhibit the same independence of magnetic conditions and of external temperature changes. Instruments reading up to and including 150 volts have their resistance mounted in the case. External resistances are used with instruments of a higher voltage.

Ordinarily potential transformers are used for voltages above 750. For such service a special transformer of extremely close regulation, with a rated capacity of forty watts and designed for sixty periods per second, is used. At this load and periodicity the regulation of this transformer is 0.6 of one per cent. Portable instruments are mounted in a finished oak case, provided with lock and key. Like the switchboard type, portable instruments are provided with a suitable means for bringing the pointer to zero. Laboratory instruments, from which very accurate readings must be taken, are provided with a mirror placed beneath the scale, in order that the error of parallax may be eliminated.

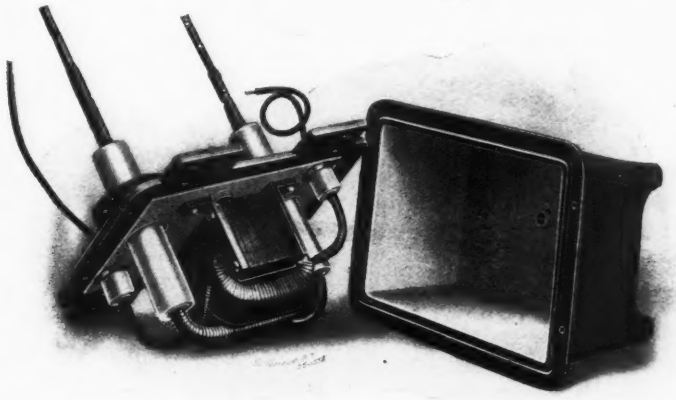


FIG. 6.—SERIES TRANSFORMER, OIL TYPE, KNOCKED DOWN.

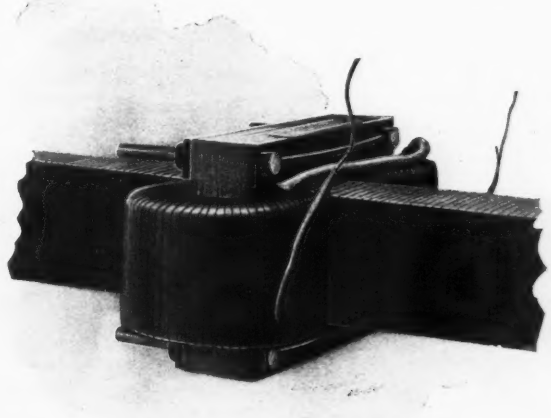


FIG. 7.—SERIES TRANSFORMER, BUS-BAR TYPE.

New Electric Turntable in Germany.

A new type of electric turntable has been developed in Germany for use in railway yards. The apparatus consists of a small motor mounted on the side of a table. Motion is communicated to the latter through gears. A simple type of controller is placed at a convenient point on the turntable, and current for operation is taken, by means of a trolley, from an overhead wire.

Some New Telephone Specialties.

The accompanying illustrations show some telephone specialties which have been developed by the Eureka Electric Company, Chicago, Ill. Fig. 1 is a view of a complete portable desk set. This can be used either for central energy or series and bridging magneto service. The stand is furnished either in full nickel-plate or polished and lacquered copper, the standard being of solid engine lathe turned metal, highly finished. It is furnished complete with a terminal block, series or bridging hand generator in box, and extension bell of any resistance. A view is given in Fig. 2 of the Eureka triplet set.

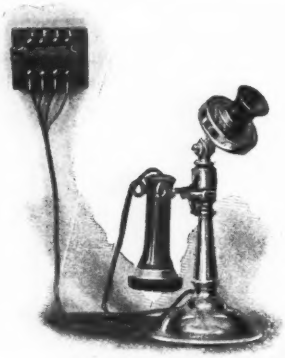


FIG. 1.—PORTABLE DESK SET.

FIG. 2.—TRIPLET TELEPHONE SET.

This instrument combines in a most compact form all parts in the complete talking circuit of a long-distance telephone. It can be readily attached to any type of telephone, which will be appreciated by those having old-style telephones in which the generators and ringer movements are in good working order, but where the talking apparatus is not standard and up to date. This set is furnished with the Eureka long-distance non-packing transmitter, No. 20 Eureka receiver, long-distance induction coil, automatic hook with heavy rim pattern, which decreases the possibility of breakage. The permanent magnet is made from the very highest platinum contacts, adjustable transmitter arm with japanned iron retaining-box.

The No. 20 receiver is shown assembled in Fig. 3, the parts of the receiver appearing in Fig. 4. The shell of this receiver is of the finest hard-blown rubber, highly polished. The cap is of the latest grade of magnet steel and is carefully hardened and finished in nickel-plate. The cord terminals are soldered to a special clip, ensuring positive connections between the electromagnets and the cords. The adjustable lug is made of brass, ensuring good wearing and permanent adjustable features. It is stated that the receiver is extremely simple to adjust, and that when once adjusted it will remain in that condition. This is stated to be a valuable feature, since the rubber is susceptible to atmospheric changes, which cause a variation in the efficiency of the instrument. To adjust the receiver it is necessary only to release one set screw. The acoustic chamber is large and of the correct design, giving the full benefits of a bipolar receiver.

FIG. 3.—RECEIVER ASSEMBLED.

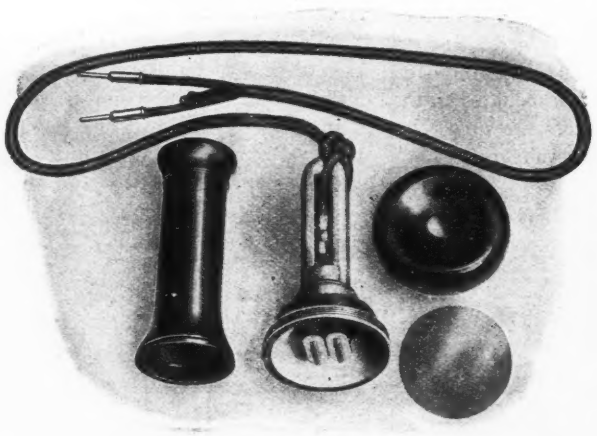


FIG. 4.—PARTS OF RECEIVER.

Fig. 5 illustrates a well-arranged chief operator's toll line switchboard.

Development in Direct-Current Meters.

During the past year there appeared in these columns a description and data regarding the development of the Halsey direct-current meter. Several improvements have been made recently and the meter has been tested in a number of laboratories of technical institutions. It is stated that these tests show that although the revolving element of this meter is submerged and floats in mercury, and the field is that of a permanent magnet, without a single turn of wire, the accuracy curve is almost a straight line indicating that the friction of commutation and supporting bearings is reduced to a minimum. It is said that the tests made at Cornell University and other institutions show the amount of current required to overcome the standing friction of station and maintain rotation varies from 0.03 to 0.04 of an ampere.

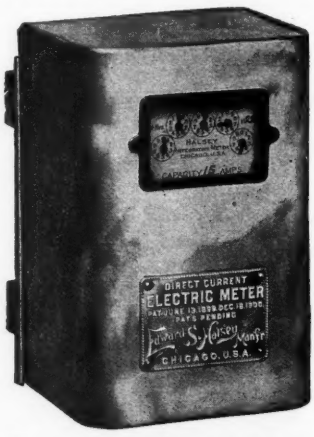


FIG. 1.—DIRECT-CURRENT METER.

FIG. 5.—CHIEF OPERATOR'S TOLL LINE SWITCHBOARD.

Another striking characteristic of this meter is that its drop at full load between the terminals is only about 0.007 part of an ampere, and on this account it is possible to connect this meter up with

a shunt of a very large carrying capacity for large switchboard meters. Mr. Halsey has just completed a 12,000-ampere meter of this nature for the works of the

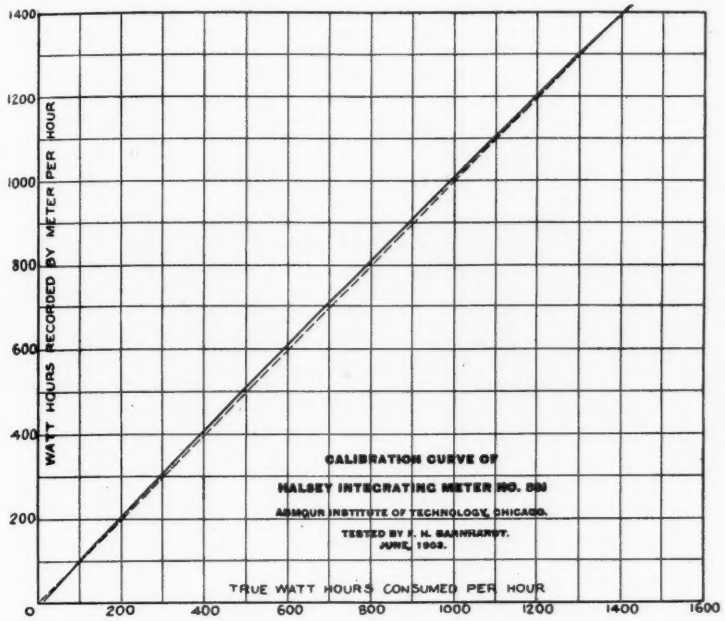


FIG. 2.—DIAGRAM OF ACCURACY CURVE.

Carnegie Steel Company, at Youngstown, Ohio.

An extremely high torque is claimed for this meter, amounting to 11,000 centimetre dynes, with infinitesimal mechanical friction.

This meter is virtually an ampere-hour meter, geared and calibrated so as to show directly upon its face the number of watt-hours that have been passed through it at the constant potential for which it is calibrated. The accompanying illustration gives a view of the meter with its cover. This meter is one of the simplest of direct-current meters, consisting essentially of a plain copper-disc armature submerged in the mercury bath so as to rotate freely in the concentrated field, maintained by the powerful permanent magnet, in a one-eighth-inch gap of about one circular-inch area. This armature disc is made to rotate by the current being led to it and through it by the mercury at the centre of this concentrated field.

Fig. 2 is a diagram of an accuracy curve described by a twelve and one-half ampere, 110-volt meter, that was made at Armour Institute, by which it is shown that there is no point where there is an appreciable error between a point below any minimum commercial load to overload. This meter is manufactured by Edward S. Halsey, Chicago, Ill.

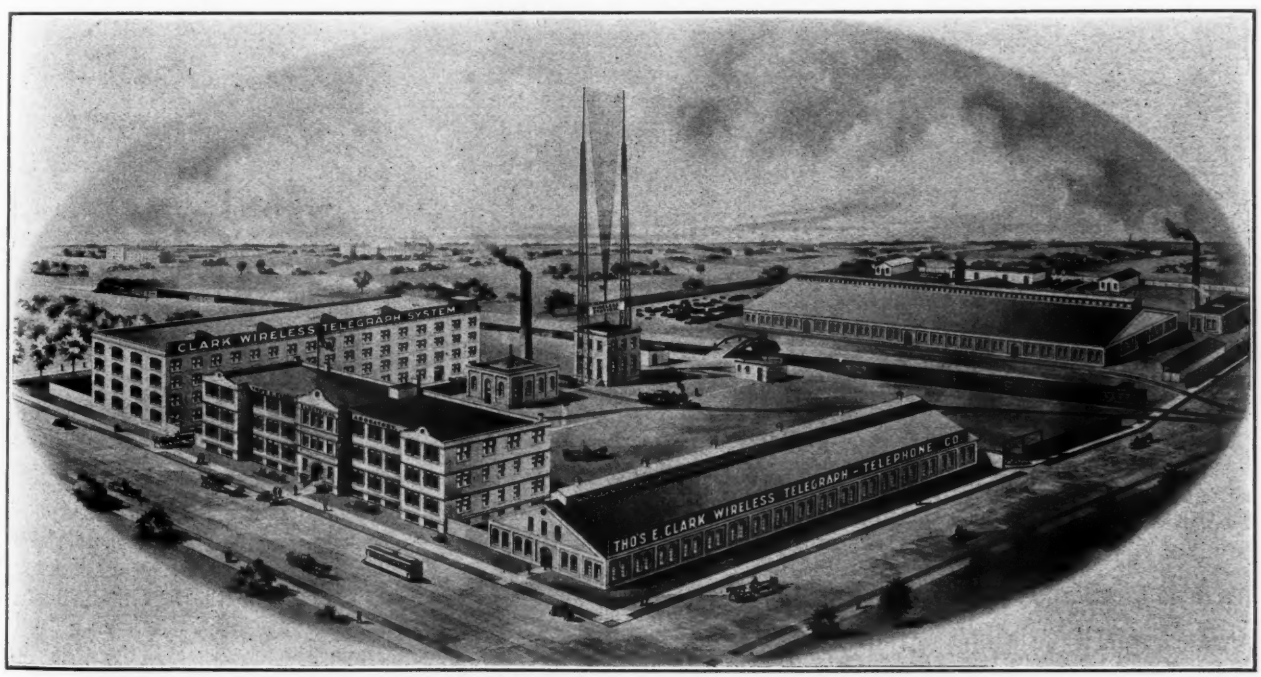
Large Wireless Telegraph and Telephone Factories.

The accompanied illustration shows the factories of the Thomas E. Clark Wireless Telegraph and Telephone Company. The factory is located in Pontiac, Mich., and when completed will cover an area of nearly six acres. Pontiac is an active manufacturing town about thirty-five miles from Detroit, to which it is connected by steam and electric railways.

The main office is 120 feet long by 50 feet wide with a high basement and has a floor space of 2,400 square feet.

The electrical laboratory is situated on a high point overlooking the surrounding country and will be fitted with an aerial tower 250 feet high. This building will be used for the experimental work, which is being carried on actively and continuously. The factory will be thoroughly equipped with the best machinery, which is now going on.

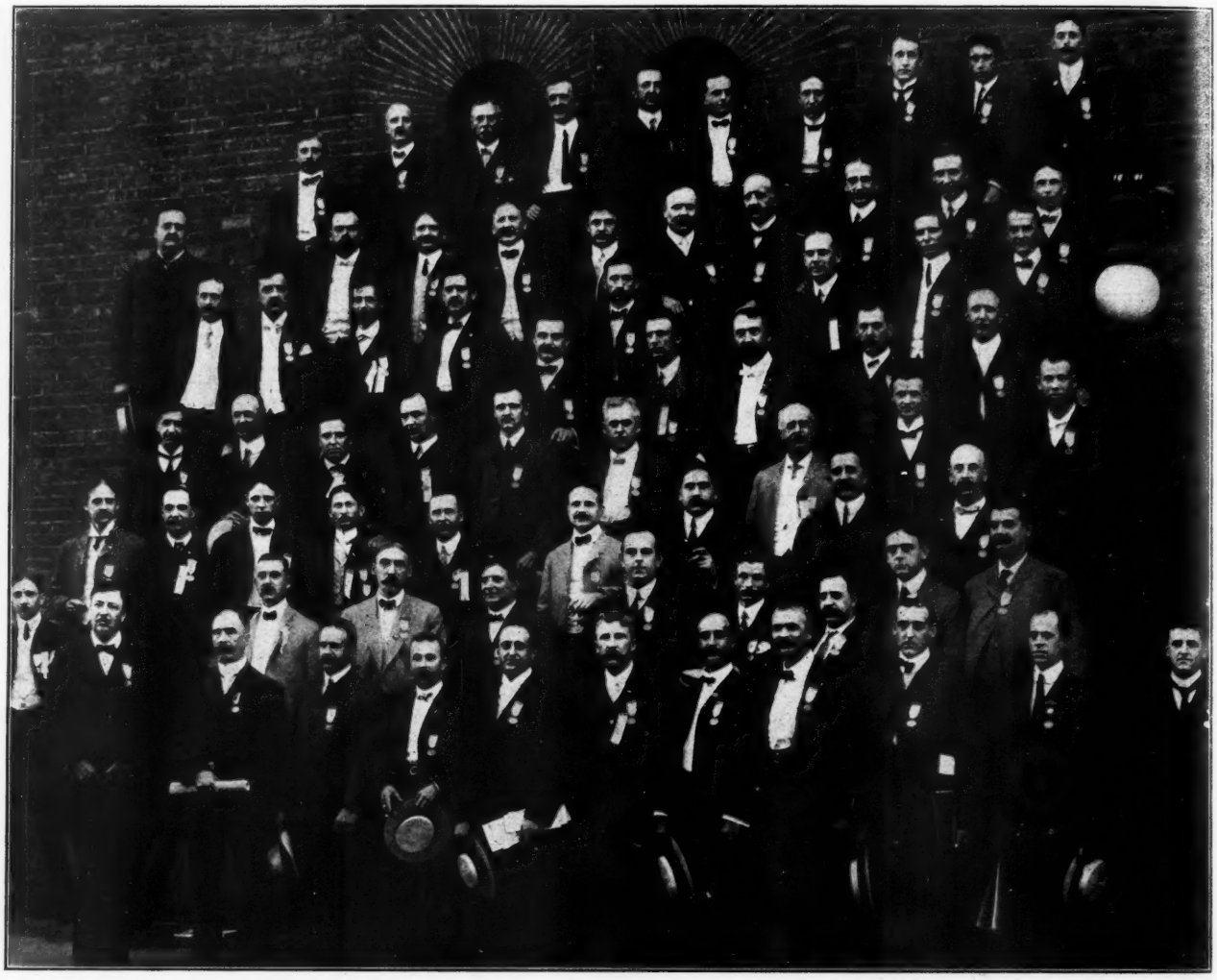
The active management of the company consists of Thomas E. Clark, president and general manager, and Gustave F. -Recfstahl, secretary and general superintendent, and from the announced plans of the company and well-known energy of its officers substantial results may be expected in the development and application of wireless telegraphy.



LARGE WIRELESS TELEGRAPH AND TELEPHONE FACTORIES.

National Electrical Contractors.

A photograph of a few of the gentlemen attending the convention of the electrical contractors is presented on this page. This group was taken at Detroit during the convention week, July 14 to 17, and includes several of the officers of the association. There were about six hundred in attendance at the convention, and the occasion was a highly successful one and important in its influence on electrical work of all kinds in the future.



A Group of Members of the National Electrical Contractors' Association—Photographed at Detroit.

Electrical Installation at Durham, N. C.

The Blackwell's Durham Tobacco Company has recently placed an order with the Westinghouse Electric and Manufacturing Company for an alternating-current generator, seventy-five kilowatts capacity, 250 volts, 3,000 alternations, 500 revolutions per minute, this being the third generator ordered by this well-known tobacco company for its factory at Durham, N. C.

About two years ago the initial installation was made of a 150-kilowatt, 3,000-alternation, 200-volt, belted type Westinghouse alternator, together with exciter and switchboard, and also about 150 horse-power in Westinghouse induction motors, ranging in capacity from three to twenty horse-power. These motors are used to drive the various machinery used in the manufacture of this brand of smoking tobacco.

The original electrical installation proved so successful that last year the tobacco company decided to install an additional generator and ordered a Westinghouse seventy-five-kilowatt, two-phase, 220-volt, 3,000-alternation, belted generator, complete with switchboard. This was arranged to run in parallel with the previous generator.

The factory has now been further enlarged and it was found necessary to increase the output of the combined plant which led to the placing of this recent order for a seventy-five-kilowatt generator and a new switchboard arranged for the control of all three generators, and also the necessary feeders.

By having three generators of the above sizes it is enabled to shut down certain generators when only a few departments in the factory are in actual operation, thus making a highly economical plant. Previous to the installation of electrical apparatus, when it was found necessary to operate one division of the factory overtime or if it was found advisable to shut down some other department and operate the rest of the machinery, there was a constant loss in the shafting due to the fact that all of the line shafting had to be run to operate one part of the factory. Under the present arrangement the departments can be operated or not as desired without operating any useless shafting.

From tests taken at this plant about a year ago, it was found that with the power required for the old factory and also for two new buildings the friction load was fifteen per cent less than when the old building alone was driven by shafting method.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW AUSTRALIAN ELECTRIC TRACTION SYSTEM PROJECTED—It is reported that an electric railway will be constructed from Melbourne to Whittlesea *via* Fitzroy. The distance is twenty-six miles. The scheme contemplates a continuous tramway between Whittlesea and a suitable terminus in Melbourne and the total cost of construction and equipment is put at $850,000.

BIG ELECTRIC LINE PROPOSED FOR MONTANA—The Butte & Salmon River Electric Railroad Company, with a capital of $2,000,000, has been incorporated at Helena by P. B. Moss and other eastern Montana men. The company proposes to build a railroad of 187 miles from Butte to a point in the Salmon River country in Idaho at or near the mouth of the North Fork, by the way of Horse Prairie and Lemhi Pass.

TO BUILD ELEVATED TO BRIGHTON BEACH—The Brooklyn Rapid Transit Company announces that it will spend $1,000,000 in the reconstruction of the old Brighton Beach line. Under the law the company must do away with all grade crossings. It has been found impossible to depress the tracks, so the problem was met with a plan to make the road an elevated one from Prospect Park to the beach, where it now runs on the surface.

OMAHA ELECTRIC LIGHT DEAL—The Omaha Electric Light and Power Company, a recently organized $3,000,000 corporation, has taken over the property of the Omaha Thomson-Houston Electric Light Company, together with the two lighting companies of Council Bluffs. Floating indebtedness of $400,000 and bonded indebtedness of $298,000 will be taken up and new bonds to the extent of $1,500,000 issued. The new company is organized under the laws of the state of Maine and a number of its heavy stockholders are residents of Boston. It is announced there will be no change in the management of affairs of the concern.

RECEIVERS' CERTIFICATES TO BE ISSUED—It is announced that four million dollars worth of receivers' certificates will be issued by the receivers of the Union Traction Company, of Chicago. Judge Grosscup has authorized the issue, which will be used to take up the floating indebtedness of the company and the underlying concerns, the West and North Chicago corporations. The indebtedness thus will become an obligation of the court, and must be paid before the reorganization is undertaken. Notices of the stockholders' meeting of August 19 have been sent out. There are 7,000 stockholders, and each will receive about four pounds of mail, consisting of documents pertaining to the plans and history of the street car companies.

WIRELESS COMPANIES' DISPUTE—A cable despatch states that the German Wireless Telegraph Company, which was recently organized through the amalgamation of the Slaby and Braun systems, has issued a statement regarding Signor Marconi's utterances on the possibility of the German company intercepting Marconi messages to England. It is stated that Marconi's opinion that such interception is only possible if the German company's stations are erected in England is erroneous. The German company says that all that is necessary is to erect a strong station on the shores of the Baltic or the North Sea, attune its receiving wires to Marconi's station at Poldhu, Cornwall, and it would be impossible for Marconi to receive transatlantic messages.

TO ATTEMPT TO CROSS ARCTIC CIRCLE—Mr. and Mrs. Charles J. Glidden, of Lowell, Mass., left Copenhagen on July 29 in their automobile in an attempt to make a trip in the Arctic zone. The United States consul accompanied them to Elsinore and arranged for their safe passage across the country. The route lies through Christiana and thence northeastward to Bergen. From there the direction will be changed to the northwest through Trondjham, from where the dash across the Arctic line will be made, Beleren being the objective point. This town is about thirty miles north of the Arctic circle. The return trip will be made through Denmark, and after a trip through Holland and Germany they will go to England. Mr. Glidden was well known in telephone circles for a number of years, being at the head of the Erie Telephone and Telegraph Company.

NEW CUBAN ELECTRIC COMPANY—The Havana Electricity Company, Limited, has been organized in London with a capital of $1,500,000, for the purpose of adopting an agreement with Don Tiburcio Castaneda and La Compania de Electricidad de Cuba to construct, equip, develop and control railways, tramways, electric light, telephone and telegraph works and other public and private works in Cuba and elsewhere; to acquire all or any part of the shares and bonds of La Compania de Electricidad de Cuba, which is organized under the laws of Cuba and has a concession for the establishment in Havana of an electric plant; to acquire shares and obligations of any other company, and to carry on the business of supplier of electric light, heat and power, and a general electrical business. The registered offices of the company are in London.

NEW YORK-BOSTON TROLLEY—A decision of Judge Elmer in the Superior Court, granting a trolley charter to build an electric road from Montowese, a small town a few miles north of New Haven, to Wallingford, five miles further north, closes the last gap in the trolley line from New York to Boston. With the completion of this line a through service will be established between the two cities, with the exception of perhaps one change. The distance by trolley is 251 miles, and the quickest time in which the trip can be made is twenty hours. The road passes through the most picturesque part of Connecticut and Massachusetts. From Boston to Worcester the line runs along the Charles River, through expanses of farm land. At Springfield the course of the Connecticut River is followed to Hartford, and from Hartford to New Haven the route is by way of New Britain. From New Haven to New York the trolley line follows the New York & New Haven road in an almost parallel line.

PROPOSED REGULATIONS FOR THE OPERATION OF TROLLEY CARS—The New York *Times* comments as follows on the question of the operation of urban and suburban trolley roads, which is now attracting attention in the state of Massachusetts. "Urban and suburban trolley lines, despite their many similarities, are yet made quite different things by the difference of the conditions in which the service is conducted, and especially by the higher speed invariably maintained in the country. The general failure to recognize this fact is at the bottom of many of the accidents daily occurring on the suburban lines, which, being in reality under-sized railroads instead of over-sized street car companies, follow the methods of the latter at the great peril of their passengers. There is, therefore, pertinency, if not any large amount of practical wisdom, in some suggestions just made in an open letter sent to Governor Bates, of Massachusetts, by Mr. W. H. Wheeler, of Worcester. Mr. Wheeler wants the legislature to see to it, first of all, that no motorman shall be employed on a country trolley line until he has had two years' experience, and has, besides, proved to a state licensing board that he is able to do the right thing in an emergency as well as to manage his car when no dangers are in sight. Just how the test is to be made is not revealed, and not much would be revealed by prearranged difficulties. Still, something could be done in this direction, and the idea has certain merits. In the next place, Mr. Wheeler would have the state pass a law forbidding one rapid transit car to follow another at a less distance than 100 yards—which seems extremely close—and ordering the equipment of all such cars with a double set of air brakes, so that one could be used in case the other failed. That, we fear, is a counsel of perfection and not to be expected while the world and corporations remain what they are. It must be remembered, however, that the transportation companies, for the very best of reasons, are struggling with many another problem, and legislative interference should be slow and cautious in matters upon which the practical expert alone has a right to speak the final word."

ELECTRIC LIGHTING.

PLAINFIELD, WIS.—T. Starks and F. V. Skeel will light the village by electricity.

HUDSON, MICH.—The North Adams council has let the contract for the village lighting plant.

BOSTON, MASS.—The Pittsfield Electric Company will increase its capital stock from $100,000 to $150,000.

BETHEL, OHIO—This town will install an electric lighting plant, $8,000 in bonds to be issued for the purpose.

CARROLL, IOWA—A twenty-five-year franchise has been granted to the Carroll Electric Light and Power Company.

RICHMOND, IND.—The Richmond Light, Heat and Power Company announces that it will double the capacity of its plant.

RALEIGH, N. C.—Burlington has decided to issue bonds to the amount of $18,000 for the purpose of installing an electric light plant.

MARION, OHIO—The Marion Railway, Power and Lighting Company announces that it will build a $350,000 power and lighting plant in this city.

RIVER ROUGE, MICH.—At a special election it was decided to issue bonds to the amount of $28,000 for the purpose of building a municipal electric plant.

NEEDHAM, MASS.—The town selectmen have signed a contract with the Greendale Chemical and Electric Lighting Company for street lighting for five years.

PORTSMOUTH, OHIO—The contract for erecting a $100,000 power-house has been let by the Portsmouth Street Railway and Light Company, and work will commence at once.

FAIRMOUNT, IND.—Nearly all the money necessary for the building of the city electric plant has been subscribed, and it is hoped to have the plant installed before the winter.

MERIDIAN, MISS.—Work has been commenced on the new power-house which is being erected by the Meridian Light and Railway Company, and will be pushed with all possible speed.

WOONSOCKET, R. I.—The city has entered into a five-year contract with the Woonsocket Electric Machine and Power Company to light the streets. The city is to pay at the rate of forty cents per light per night, and also has a contract for incandescent lights at $30 a year per light.

FORT WAYNE, IND.—The city of Fort Wayne has entered into a contract with the Fort Wayne Electric Light and Power Company to light the streets. The city is to use 324 arc lamps and to pay at the rate of $75 per lamp per year. The contract is to continue in effect until January 1, 1935.

NASHVILLE, TENN.—For the first six months of the present year the operation of the city electric plant, including the expenditures made for additions and equipment, has been $36,525.38. This does not include $6,137.90 expended for gas light and $3,000 interest on the $150,000 bonds issued for the purchase of the plant, which would make the total expenditure of the light department under municipal ownership for six months $45,663.28.

HAVERHILL, MASS.—An order has been issued by the Board of Gas and Electric Light Commissioners, sustaining an appeal by the Haverhill Electric Company from a decision of the board of aldermen of Haverhill in favor of the Haverhill Illuminating Company, and annulling the action of the Mayor and aldermen in granting the Illuminating Company the right to carry on the business of supplying electric light and power in the city.

MARINETTE, WIS.—The Penn Mining Company, of Norway, Mich., will, it is stated, shortly start the work of harnessing the water power at the mouth of the Sturgeon River at Norway, just across the line from Marinette County. A bill was passed in the last Wisconsin Legislature to allow it to build a dam in Marinette and Menominee counties. Plans have already been drawn for the improvement, which will cost over $500,000. Electric power will be developed for running the mines, and it is also planned to light Norway by electricity and later build an interurban line to connect all the Menominee range towns.

ELECTRIC RAILWAYS.

PITTSBURG, PA.—The new line of the Pittsburg Railways Company to Trafford City has been opened. The distance is about eighteen miles, and the time taken is one hour and twenty minutes.

PHILADELPHIA, PA.—A charter has been issued by the state department to the Central Pennsylvania Traction Company, of Harrisburg, with a capital of $2,100,000, to operate the lines of the Harrisburg Passenger Railway Company and the East Harrisburg Street Railway Company.

EVERETT, WASH.—It has been officially announced that the Everett Improvement Company, which has for some time contemplated building a trolley line from Everett to Snohomish, has leased the branch line of the Northern Pacific between the two cities, and will immediately install the service.

JAMESTOWN, N. Y.—Active work has been commenced on the proposed trolley road from Jamestown to Mayville. A new power-house is being erected in this city, and substations will be erected at Ashville, Stowe and Mayville. It is stated that the road will be in operation before the end of the present season.

MARION, IND.—Joshua Strange has been granted a franchise by the county commissioners to build and operate a passenger and freight electric line from Marion to Van Buren, and thence south to Upland. The franchise is for fifty years and the road is to be in operation by September, 1905. The power-house will probably be located in Marion.

BANGOR, ME.—The railroad commissioners have granted a charter for an electric railroad between Presque Isle and Perham, both towns in Aroostook County. The road will be sixteen miles long, and will be intended primarily for the transportation of farm products, although passengers and mails will be carried. It is stated that the capital stock has been subscribed almost entirely by farmers along the route.

ANDERSON, IND.—A mortgage for $5,000,000 by the Indiana Union Traction Company to the Girard Trust Company, of Philadelphia, has been filed for record here. It secures a bond issue by the Indiana company and is payable thirty years from July 1, 1903. The mortgage covers existing systems leased by this company and such additional lines as may be built in eight counties named out of ninety-two in Indiana.

PAWTUCKET, R. I.—The Rhode Island Company has issued an official statement to the effect that it will expend $1,004,070 in the reconstruction of the local street railway system. This will include the cost of laying about thirty-two miles of standard gauge track, new rolling stock, and $100,000 which the company is to pay the city toward the widening of Main street. In return, the company receives exclusive franchises in the city until 1913.

ALBION, ILL.—Articles of incorporation of the Southern Electric Railway Company have been filed for the record. The company has a capital of $50,000, and proposes to construct an electric railroad from East St. Louis through the counties of St. Clair, Clinton, Washington, Marion, Jefferson, Hamilton and White to a point on the Illinois side of the big Wabash River, at or near the town of Maunie. The principal office of the company will be located at Mount Vernon.

HARRISBURG, PA.—It is stated that New York capitalists have become interested in the building of a new trolley line from Steelton to New Cumberland, and thence to Bowmansdale and Mechanicsburg, with a branch line from Bowmansdale to Dillsburg. The road will be twenty-three miles long and will touch the following towns: Mechanicsburg, Kollerton, Shepherdstown, Bowmansdale, Lisburn, Silver Lake Park, Lewisberry, New Market, New Cumberland and Steelton, Bishop's Park, Siddonstown, Mount Pleasant and Findley's Church.

MUNCIE, IND.—The Consolidated Traction Company, which is now building a line to Crawfordsville, by the direct route through Jamestown, will, it is stated, build a line from Crawfordsville to La Fayette, and extend the Indianapolis-Crawfordsville line on to Danville, Ill., through Veedersburg and Covington, and will build a coal road from Crawfordsville down into Parke County. The road will be a coal-carrier into Indianapolis. It is probable that the road into Parke County will be pushed on to Rockville, where it will connect with the Danville company's line into Clinton and Terre Haute.

ELECTRICAL SECURITIES.

It is with a feeling of general relief that Wall street has settled into a sort of satisfied rest. The spasm of activity and violence that shook several business houses into ruin has evidently passed, and left behind it little of the fear that generally attends a like movement. It is assumed that the suspended local firms will soon resume business. Following the drop in prices there was considerable buying both by large interests and by the speculating outsiders. The bargain conditions were soon eliminated, however, by the quick recovery of prices.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 1.

New York:	*Closing.*
Brooklyn Rapid Transit	45¼
Consolidated Gas	187
General Electric	162
Kings County Electric	155
Manhattan Elevated	132¾
Metropolitan Street Railway	119
New York & New Jersey Telephone	161
Westinghouse Manufacturing Company	170

The statement of the Brooklyn Rapid Transit Company for the nine months ending March 31, 1903, is as follows: Gross earnings, $9,905,176; disbursements, $5,870,373, leaving net profits of $4,034,803, an increase of $801,214 over those for the corresponding period of the previous year.

It is stated that Manhattan Elevated earnings are showing an increase of $4,000 a day, as compared with last year, and that from the present outlook the company will earn 10 per cent for the fiscal year.

The Consolidated Gas Company has declared the regular quarterly dividend of 2 per cent, payable September 15. Books close August 27 and reopen September 16.

Boston:	*Closing.*
American Telephone and Telegraph	131½
Edison Electric Illuminating	225
Massachusetts Electric	80
New England Telephone	120
Western Telephone & Telegraph preferred	83

Although June this year was a poor riding month, Boston Elevated gross earnings amounted to $1,040,000, and during that month there was a total of 3,987,000 car-miles run, as compared with 3,958,000 miles in June, 1902. For the first three weeks of July, the gross earnings were $100,000 in excess of those of last year.

Philadelphia:	*Closing.*
Electric Company of America	8
Electric Storage Battery common	59
Electric Storage Battery preferred	59
Philadelphia Electric	5½
Union Traction	44
United Gas Improvement	85

It is stated officially that the net earnings of the Electric Storage Battery Company for the six months ending June 30 were $1,200,000, by far the largest for any similar period in the history of the company. The net earnings for the entire year of 1902 were $1,113,199. Of last year's total earnings $812,427 were paid out in dividends, so that the net for six months ended June 30 last enabled the company to pay a full year's dividend and still possess a surplus of $387,573.

Chicago:	*Closing.*
Chicago Telephone	125
Chicago Edison Light	148
Metropolitan Elevated preferred	54
National Carbon common	22
National Carbon preferred	90
Union Traction common	5
Union Traction preferred	30

It is reported that the Union Traction statement for the year ending June 30 last shows a deficit of $240,000.

OBITUARY NOTICE.

MR. CHARLES ANTHONY MORSS died at Boston, July 27, of heart disease, aged seventy-one years. Mr. Morss was a pioneer in the wire business, and for several years had been at the head of the Simplex Electrical Company, which manufactures the Simplex wire. He was born in Boston in 1822, and his ancestors on both sides were among the original Puritan settlers of Newburyport. Mr. Morss entered the wire business soon after leaving school with a firm which occupied the Cornhill Building, which had been for nearly sixty-five years his headquarters. His widow and four sons survive him.

PERSONAL MENTION.

MR. H. F. T. ERBEN, of the General Electric Company, Schenectady, N. Y., is a son of Admiral Erben, United States Navy, and is taking high rank in electrical work. A recent patent issued to Mr. Erben for a dynamo coil has been assigned to his company.

MR. C. E. FARRINGTON, treasurer of the Massachusetts Chemical Company, Boston, Mass., sailed for Europe last week. Mr. Farrington expects to be away eight or nine weeks, and will combine business with a well-earned rest from a very active life in the electrical field.

MR. F. L. DAME, for the past two years general manager of the Union Electric Company, Dubuque, Iowa, has accepted the position of engineer of the local companies' committee of the General Electric Company. It is expected that Mr. Dame will assume his new duties with headquarters at Schenectady, N. Y., about the middle of August.

MR. H. M. KOCHERSPERGER, New Haven, Ct., controller of the New York, New Haven & Hartford Railroad, has been elected president of the Stamford Street Railroad Company, succeeding Colonel N. F. Heft, resigned. Mr. Kochersperger is one of the best known men in his profession in the United States and while retaining his important position with the New Haven road, will bring to the electric railway energy and executive ability of a high order.

COLONEL N. F. HEFT has resigned from the presidency of the Stamford Street Railroad Company, which is owned by the New York, New Haven & Hartford Railroad Company, and also from the presidency of the Meriden Street Railroad Company, of Meriden, Ct. Colonel Heft's retirement is due to a desire for a long vacation in Europe. He will retain his interest in the Stamford Railroad Company, of which he is a director. It is believed that plans are under way to extend the Stamford railroad so that through service between that point and New York city can be given.

SIR WILLIAM H. PREECE, consulting engineer to the British Post Office, is critically ill with pneumonia. His son, Mr. Llewellyn Preece, who arrived at New York on the steamer Lucania last Saturday, making the trip with Mr. Franck Z. Maguire of the Bridgeport Brass Company, found a cable message awaiting him announcing the sudden illness of his father. This was Mr. Llewellyn Preece's first visit to this country, where he intended to inspect the electric railways, and to visit the electrical developments at Niagara Falls. A second message was received asking him to return at once and he left on a returning steamer two hours after his arrival. Sir William Preece is consulting engineer for the British Post Office. He is associated with his sons and Major Philip Cardew as consulting engineers, and has a very large practice throughout the United Kingdom and the British colonies. He is an accomplished lecturer, a distinguished scientist and inventor, and is the author of many valuable books and papers.

TELEPHONE AND TELEGRAPH.

OWENSBORO, KY.—An automatic telephone exchange is to be constructed by the Home Telephone Company.

COLUMBUS, GA.—The Columbus Automatic Telephone Company has been granted a franchise in Phenix City.

KOKOMO, IND.—The council has granted a forty-year extension of franchise to the Citizens' Telephone Company.

SPRINGDALE, WASH.—The Springdale & Cedar Cañon Telephone Company's line has been sold to O. U. Hawkins, of Springdale, by E. M. Denny and W. I. Reeves.

CEDAR RAPIDS, IOWA—A new telephone company has been formed by J. P. Shurman, O. A. Ontje and J. Laverka, to establish a farmers' telephone line for this vicinity.

WORSHAM, VA.—The Southside Telephone Company has been incorporated by the following: J. D. Eggleston, Jr., P. Winston, K. T. Crawley, E. W. Venable and W. M. Holliday.

CLEVELAND, OHIO—The Cuyahoga Telephone Company has issued a letter to its employés announcing that beginning July 1, after paying all expenses, taxes and interest on bonds, it will set aside one-fifth of the surplus remaining, and distribute this during January to all in the employ of the company at that time, in proportion to the salary of each and the time of his connection with the company.

INDUSTRIAL ITEMS.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, will send its "Transformer Blue Book" on request. This contains interesting information of the kind that transformer users should have.

THE OKONITE COMPANY, LIMITED, New York city, reports one of the busiest summer seasons in its history. Its extensive factories at Passaic, N. J., are very busy, often working overtime to fill orders promptly.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., in its recent report, makes a particularly fine showing. The profits for the year are announced to be the largest in the history of the company.

THE NERNST LAMP COMPANY, Pittsburg, Pa., through its Portsmouth, N. H., agents, Messrs. W. T. Trafton & Son, recently closed a contract with H. C. Hewitt & Company, of Portsmouth, N. H., for a number of six-glower Nernst lamps. These lamps have been installed and, it is stated, are giving entire satisfaction.

CHARLES E. MILLER, who has a large automobile supply house with headquarters at 97-101 Reade street, New York, has opened a branch store in "Automobile Row" on West Thirty-eighth street, New York city. Mr. Miller keeps a very complete line of automobile supplies, and represents the Dayton Electrical Manufacturing Company, of Dayton, Ohio.

THE WRENN COMBUSTION GOVERNOR COMPANY, 290 Broadway, New York city, manufacturer of combustion governors, steam damper regulators, diaphragms, valves, etc., has issued an illustrated catalogue giving a very complete description of the Wrenn combustion governor, as well as additional valuable data relative to this subject. Any one interested can obtain the catalogue by a request to the company.

THE WARREN ELECTRIC MANUFACTURING COMPANY, Sandusky, Ohio, under the able management of President C. C. Warren, has recently been extending its manufacturing facilities to meet the requirements of a rapidly expanding business. The Warren alternator is widely and favorably known, and the company has branch offices in all the leading cities. The large extension was completed this year, and the company is now able to promptly handle all orders for its product.

THE ELECTRICAL REVIEW has been in receipt recently of a number of very attractive catalogues published by the various manufacturers in the electrical and allied fields. All this literature is of a high grade and is evidently carefully prepared. The catalogues not only present the excellent qualities of the various products, but in nearly every instance contain valuable information that will interest consumers and the lay public generally. Probably no industry was ever so well supplied with such excellent literature.

THE FOUR-TRACK NEWS for August, published by George H. Daniels, of New York, is a very comprehensive and beautifully illustrated issue. The frontispiece is a particularly fine half-tone reproduction of Sir Thomas Lipton's challenge yacht, Shamrock III. This is one of the best pictures of the yacht that has yet been presented. The number contains some seventy pages of interesting and well illustrated text, covering a great variety of subjects, keeping particularly in view the outing advantages and recreation spots of this country.

THE LAWRENCE-HALL ELECTRIC COMPANY, Cincinnati, Ohio, organized a few months ago with Mr. F. D. Lawrence as president and treasurer, and Mr. William Albert Hall as vice-president and secretary, is meeting with pronounced success in extending its business in a very important and progressive territory. This company, in its recent announcements, calls attention to the admirable location of Cincinnati for supplying its various products economically as regards express and freight rates. The company carries large stocks of standard electrical equipments, and is agent for all the Okonite products.

THE HYDRA BATTERY COMPANY, 72 Reade street, New York city, announces that the orders for its "Hydra" type and "Vesuvius" dry-cell batteries continue to keep it busy to its full capacity. The company states that it is experiencing considerable success in the sale of its new "Hydra" jump spark plug. This plug is constructed in one solid body, thus avoiding loose joints, and is insulated with the best grade of imported mica washers. It is furnished with a brass head, thus preventing rust in the cylinder head, and has extra heavy platinum points. The company will be pleased to furnish full information upon request.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has issued bulletin No. 136, descriptive of "S. K. C." induction motors. This describes the construction of the type of induction motor which has recently been brought out by this company to complete its line of alternating-current apparatus. The motors are built for twenty-five, forty and sixty cycles, in sizes up to 200 horse-power. In addition to the constant-speed motor a type of variable-speed motor has also been developed. The motors may be mounted in any position, either on the floor, wall or from the ceiling, and are designed for the several standard potentials.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., in its bulletin No. 4 describes its generator-call telephones. The catalogue is a very handsome one, and among the apparatus illustrated is the following: Transmitter arms, lightning arresters, bridging telephones, extension bells, central checking telephones, induction coils, combination telephones, divided-circuit telephones, dry battery type telephones, hand generators, generator-call telephone parts, hook switches, magnetos, portable combination telephones, portable desk telephones and test sets. The company will be pleased to send this on request, and also announces that it now publishes a perpetual price list on the loose-leaf method, covering various lines of its product. This can be secured by interested parties.

MESSRS. KELLER, PIKE & COMPANY, 112 and 114 North Twelfth street, Philadelphia, Pa., mechanical and electrical engineers and contractors, have been awarded the contract for the entire electrical equipment in the new Pennsylvania State Capitol at Harrisburg, Pa. This contract covers six engines, aggregating 1,200 horse-power; six direct-connected generators, having a capacity of 800 kilowatts; a white Italian marble switchboard, consisting of twelve panels, with Weston instruments and Cutter circuit-breakers; electric wiring for motors, aggregating 200 horse-power, and over 10,000 incandescent lamps. The contract also includes an annunciator system connecting each member of the senate and the house with a central station, and another system connecting the head of each department with his subordinates, as well as a telephone exchange connecting the governor with the heads of the twenty departments, the president of the senate with twenty committee rooms, and the speaker of the house with forty committee rooms. All the rooms in the building are also connected by a telegraph system with a central office. This contract makes a notable addition to the already extensive line of important installations by Messrs. Keller, Pike & Company, which includes, among others, the National Export Exposition, the United States Mint at Philadelphia, and the large department store of Gimbel Brothers.

NEW INCORPORATIONS.

MAYFIELD, PA.—Independent Electric Light, Heat and Power Company. $6,000.

JERMYN, PA.—Household Electric Light, Heat and Power Company. $6,000.

JACKSON, WIS.—The Jackson Telephone Company. $2,000. Incorporators: C. W. Frank, F. P. Leish, George H. Frank and M. R. Rutledge.

JERSEY CITY, N. J.—The Southern Electric Securities Company. $1,000,000. Incorporators: Kenneth K. McLaren, Joseph M. Mitchell, Louis B. Dailey.

COLUMBUS, OHIO—The Mount Vernon Telephone Construction Company. $5,000. Incorporators: E. W. Breece, C. E. Bointer, E. O. Arnold, P. S. Keiser and H. C. Devin.

CANNON FALLS, MINN.—Cannon River Electric Power Company. $500,000. Incorporators: Foster B. Seager, Edward J. Peters, A. L. Ober and Thomas T. Comstock.

WASHINGTON, D. C.—The International Motor and Power Company. $15,000,000. Incorporators: H. H. Darneille, W. L. Walter, B. H. Brockway, E. G. Siggers, C. H. Fred, John M. Carpenter, J. S. Zeigler, S. H. Bell and Alexander H. Bell.